The Dock and Harbour Authority

No. 239. Vol. XX. Edited by BRYSSON CUNNINGHAM, D.Sc., B.E., F.R.S.E., M.Inst.C.E. SEPTEMBER, 1940

Editorial Comments

Transportation on the Great Lakes.

The leading article in this issue departs from our normal practice of describing a single prominent port or harbour; it is, in fact, a survey by a distinguished American engineer of a vast regional water transport system.

The widespread and extensive chain of immense lakes lying on the joint border of Canada and the United States, together with their ramification of connecting channels and tributary influents, constitutes a most remarkable natural system of internal waterways, unparalleled elsewhere in the world. The aggregate water surface is 95,000 square miles, of which nearly two-thirds is in United States territory. In sequence, from West to East, they are Lake Superior (31,810 sq. miles), Lake Michigan (22,400 sq. miles), Lake Huron (23,010 sq. miles), Lake St. Clair (460 sq. miles), Lake Erie (9,940 sq. miles) and Lake Ontario (7,540 sq. miles).

The navigational and commercial importance of these lakes can be gauged from the numerous ports and cities along their shores, including such populous manufacturing and industrial centres as Duluth, Milwaukee, Chicago, Detroit, Cleveland, Buffalo and Toronto. Penetrating "as the crow flies" a distance of fully twelve hundred miles into the North American Continent from the Atlantic seaboard, with which they are connected, naturally by the River St. Lawrence and artificially in part, by the New York State Barge Canal to the River Hudson, they are of inestimable value in promoting the economic prosperity of the United States and in a slightly less degree perhaps, of Canada. The cost of freight transportation in the large bulk carriers, which are the characteristic feature of lake navigation is cheaper than that of any other water transport in the world for length of haul.

These bulk carriers, used for the conveyance of coal, grain and ore, run to over 15,000 tons load capacity and consist essentially of continuous open holds, some more than 600-ft. long and as much as 70-ft. wide and 29-ft. deep. The propelling machinery of about 2,500 h.p. is located at the stern and the navigation bridge is set right forward, the intervening space being entirely given up to storage. The total volume of shipping using the Lakes, according to Lloyds Register returns for 1939-40 is 537 vessels of an aggregate gross tonnage of 2,538,229, as compared with 2,733 vessels of 9,336,155 gross tons of United States nationality traversing the high seas.

Naturally, these Lake carriers are not suitable for the open sea and owing to climatic conditions, traffic on the Lakes is suspended during the winter season from mid-December to the beginning of April. Despite their inland situation, storms of considerable severity are occasionally experienced and the top-heavy vessels used for passenger traffic sometimes have to sustain a buffeting which, within our personal knowledge on Lake Ontario, can be disconcerting to the traveller.

The harbours on the Great Lakes have been designed and constructed to meet these exceptional conditions. Originally, the mouths of the rivers entering the lakes served to provide the requisite shelter, but as they became insufficient for the purpose, the quiescent areas were enlarged by lines of parallel or convergent breakwaters. extending outwards and growing longer as time went on until the enclosures became of considerable size. The breakwaters were cheaply constructed, mainly of what is termed "cribwork," i.e., latticed or open-work timber frames floated out into position and then filled with stone to take a firm bearing on the bottom or on a rubble foundation. In course of time the upper portions of the cribs often decayed and were then replaced by a concrete capping. Latterly hollow caissons of reinforced concrete, filled in solid after emplacement, have been substituted for cribwork.

Very considerable depths of water are found in the Lakes. The maximum depth in Lake Superior is 1,180-ft. and in Lake Michigan 870-ft. But great navigational depth is not called for, and indeed, until recently, the old Welland Canal between Lake Erie and Ontario set a sill of 14-ft. in depth which prevented the passage of deeper draughted vessels. The new Welland Canal, completed in 1933, with its 25-ft. deep waterway has now appreciably increased the draught available for shipping (23½-ft.) passing through to the St. Lawrence. When the new St. Lawrence deep waterway is completed, there will be direct access for seagoing craft from the Atlantic Ocean to the shores of the State of Minnesota, nearly half way across the North American Continent.

Colonel Holcombe's article describing the engineering activities of the United States Corps of Engineers in developing the ports and channels of the Great Lakes is of undoubted importance and will be read with much interest.

Grain Infestation at Ports.

At a time when, during a grave national emergency, there is necessity for the economisation to the utmost degree of supplies of foodstuffs, no apology need be offered for calling general attention to a matter of vital importance affecting the housing and storage of grain cargoes from abroad. The depredations wrought by weevils, beetles and other insects of that class are matters of common knowledge, but too often the presence of such pests is treated with relative indifference as an unavoidable infliction, or a mysterious dispensation of Providence which must be accepted as incidental to the established order of things. In fact, there was, at one time, a prevalent belief that the grain itself generated the insects, but this has gradually given way to a more rational explanation of their occurrence.

In this issue will be found a notice of an exceedingly opportune and useful Report on the infestation of grain by insects, prepared under the direction of the Department of Scientific and Industrial Research, which will repay careful study by all those who have to do with the handling and storage of grain at ports, as well by numerous others who are engaged in its production and transport. For infestation may take place at any stage on the route from the farm to the silo or warehouse, and it cannot be said that one agency or stage more than another is responsible for the outbreak of the trouble. Moreover, a considerable amount of damage may be done before the discovery of infestation is made, as is evidenced by several cases cited in the report above-mentioned. In order to check the spread of infection, prompt notification should be given to all concerned, so that the infected grain may be segregated.

A great, if not the prime, promoter of insectile breeding is dirt and the Report rightly emphasises the necessity for a high standard of cleanliness in all buildings and receptacles used for grain storage. The sweeping of ships' holds after the discharge of dust-laden freight, is often carried out perfunctorily and with less care and attention than should be given to the process. Many warehouses, of old and defective construction, harbour accumulations of dirt and refuse, which have remained undisturbed for years in cracks and crevices, as well as in odd corners, window ledges, door thresholds, stairways and other recesses. Even when cleaned with the aid of vacuum cleaners, as is done in some instances, there are possibilities of some dust escaping dislodgment.

The Report draws attention to the necessity for more scientific methods to secure cool and dry conditions of storage.

Editorial Comments—continued

It characterises the processes of storage, as generally practised at present, as "almost crude," and avers that until the causes of rise of temperature and humidity in stored grain, with consequences of "sweating" and "mintiness," are better understood, effective regulation cannot be attained. It is satisfactory to know that this aspect of the problem is receiving attention and that the Pest Infestation Research Committee has an investigation in hand, though, as it is of a complex and difficult nature, some time may elapse before reliable results can be secured. Meanwhile, every effort should be made by insistence on cleanliness and hygienic processes to safeguard, as much as possible, the foodstuffs on which the nation depends for its health and well-being.

The Port of Maracaibo and its Approach Channel.

Attention has recently been directed in the press to developments at the Port of Maracaibo, located on the Western side of the lake of that name, which forms so conspicuous a physical feature in the State of Venezuela, South America. Venezuela has, within the last twenty years, come into striking prominence as a producer of oil supplies, proving itself to be one of the most important potential sources of that commodity. Oil has been found and is being obtained throughout the whole of the lake region and even in the bed of the lake itself, though the greatest output is from the Eastern side and adjacent areas. The export of petroleum from Venezuela has grown from 120 thousand barrels in 1917, to 37,381 thousand barrels in 1926 and to 190 million barrels in 1938. (There are 6.75 Venezuelan "barrels" to the metric ton of 2,200 lbs.).

The Lake of Maracaibo is roughly about 100 miles long by 50 to 60 miles broad, and it is approached from the Gulf of Maracaibo through a narrow channel or strait, the port being located about 25 miles from the open sea. Access to the port is impeded by a natural bar at the entrance of the strait, over which the depth of water is only 12 or 13-ft. at low water springs. A dredging scheme is at present in hand by which it is hoped to increase this depth to 15 or 16-ft. Inside the lake itself there is ample depth—from 25 to 30-ft.—for all present requirements of oil tankers. Since December last, the dredger "Jamaica Bay," under the direction of the U.S. Army Corps of Engineers, has been at work on the bar in the new Ampet Channel which was opened to traffic during May of this year, with a depth of 15-ft. at low water springs.

A project is being promoted, also under the auspices of the U.S. Army Corps of Engineers, for the protection of the channel seaward of the lake, by two long breakwaters, one running in a north-easterly direction from the Zapara light on Zapara Island until it reaches a depth of 35-ft. of water, and the other from the Fort of San Carlos, extending to a depth of 25-ft. The scheme is a costly one and will require some ten years to complete. The stone for the breakwaters would have to be transported from Santa Anna on the Paraguana Peninsula, East of the Gulf of Maracaibo, and the transport question raises alternative problems of water versus rail carriage, in regard to which a decision will have to be made very shortly. Owing to the exposure of the route and the rough seas experienced from December to August, water carriage would necessitate the employment of a heavy type of barge with powerful tugs.

Ports in British Somaliland.

The turn taken by military events in the Middle East has served to focus general attention on British Somaliland where British and Italian forces have been at grips with one another. The country is a curiously unimpressive theatre for an important military campaign, consisting largely of barren desert on an undulating plateau with areas of pasturage for livestock, the care of which is the principal occupation of the nomad tribes who inhabit it. Skins are the most valuable export, the Somali goat and sheep skins being of high quality.

Ports in British Somaliland are not plentiful nor of great importance. Berbera, the chief, is about 155 miles South of Aden, at the head of a deep inlet in the coastline, the only sheltered harbourage on the South side of the Gulf of Aden. There is suitable accommodation and anchorage for ocean-going steamers in the harbour, which is 11 to 13 fathoms deep at the entrance, decreasing to 5 fathoms near the shore. Almost the only direct trade of Berbera is with Aden. Imports are mainly cotton goods, dates, rice and sugar.

Zeila, or Zaila, the only other port of note, lies near the boundary of French Somaliland and is 124 miles South-west of Aden. Formerly, it was a notable entrepôt for trade with Southern Abyssinia along a route passing through Harrar, but the opening in 1902 of the railway line from Jibouti to Addis Abbaba diverted this traffic. Up till recently, something like 10 to 15 per cent. of the exports of British Somaliland were handled through Zeila.

Somaliland, as a whole, has nominally three political divisions, corresponding to the three nationalities (British, French and Italian) which have administered it. Originally an Arab Sultanate, it acquired its most powerful influence as the empire of Adel in the 13th Century. Thereafter, it broke up. In the 19th Century the East India Company occupied a part of the coastline for trading purposes. It was conquered by Egypt in 1875 and nine years later, the portion until recently occupied by the British came into their possession. There are certain undeveloped resources in the shape of oil fields, coal fields and mica beds, mainly in the coastal region, but it cannot be said that the country is any great asset to its possessors, temporary or otherwise.

American Port Control.

It is to be gathered from American press reports that for some considerable time past, a controversy has been raging in port circles across the Atlantic, over a proposal to bring the administration of the United States ports within the over-riding jurisdiction of one or other of two public Commissions, either the Interstate Commerce Commission or the Maritime Commission, the actuating motive being the desire for the acceptance in some form of the principle of Federal Control.

It is well known that port administration on the other side of the Atlantic is carried on in a variety of ways, and by systems differing widely in many respects from those in vogue in this country and, indeed, in Europe generally. It would take too long to particularise the various forms of government, but generally speaking, they are partly local, partly state affairs, with representation, either political or municipal or both, and the present trend of opinion in port circles is in favour of unification under State control with a greater degree of uniformity in procedure.

In an article in a recent issue of *World Ports*, the organ of the American Association of Port Authorities, Mr. J. F. Marias, President of the State Board of Harbour Commissioners at San Francisco, has urged the incongruity of forcing port affairs within the administrative scope of either of the two bodies named above, by reason of the fact that the Commissions in question are essentially concerned with mobile transportation units (ships and waterway craft) while ports are not mobile at all and have functions of a totally different nature, with a primary duty to fulfil to their respective hinterlands. He suggests that there should be formed an entirely independent body, which for the "purpose of convenience," he considers might be termed the United States Port Authorities Commission.

To quote from Mr. Marias' article: "There can be no question that a United States Port Authorities Commission could work more harmoniously with other Federal branches that deal with ports, such as the United States Army Engineers, the Lighthouse Service and the Coast Guard which have recently merged, and the Coast and Geodetic Survey. It is not intended that the Port Authorities Commission should exercise jurisdiction over the units, but it is almost a certainty that the efforts of these units can best be co-ordinated by the proposed Commission. In addition, such a Commission could more easily co-ordinate the overlapping functions of the Maritime Commission and the Interstate Commerce Commission far better than either one by itself. Furthermore, under such a Commission, the extending of ports, the building of facilities and the developing of new ports would necessarily have to be shown by convenience and necessity to be in the public interest."

The enumeration of the above bodies, some of which in their relation to port work have no counterpart in this country, serves to show the complexity of the interests involved and the difficulty of co-ordinating the respective duties and spheres of action. At present, the bodies are apparently more or less independent of each other and of the local port authority, with the result that sometimes works are undertaken, which may be criticised as redundant or superfluous, and, as occurs in this country also, there is often a needless duplication of port facilities by competing authorities within the same district. It is this competitive effort to provide attractions in order to secure business locally that Mr. Marias deplores and that he would like to see restricted or abandoned.

On the other hand, there are certain arguments to be advanced in favour of open competition between neighbouring ports. Without healthy competition there is a liability to stagnation, and in this country, at any rate, we are not enamoured of state control of ports. In theory, such a system may have economic advantages, but in practice these are often outweighed by a lack of initiative, a greater pre-dilection for "red tape" and the absence of incentive to cater for shipping developments and to embark on projects involving a certain amount of legitimate risk and uncertainty.

The problem of port administrative control cannot be solved in any simple manner or by any rigid rule. It involves so many considerations that what is sauce for the goose is not necessarily sauce for the gander. We are unfamiliar with much that appertains to American port politics and have no reliable information at hand on the respective functions of the Interstate Commerce Commission and the Maritime Commission; so while reserving any expression of opinion under such circumstances, we cannot but feel that it is of undoubted advantage that the subject should be fully discussed and an effort made to arrive at the optimum conclusion.

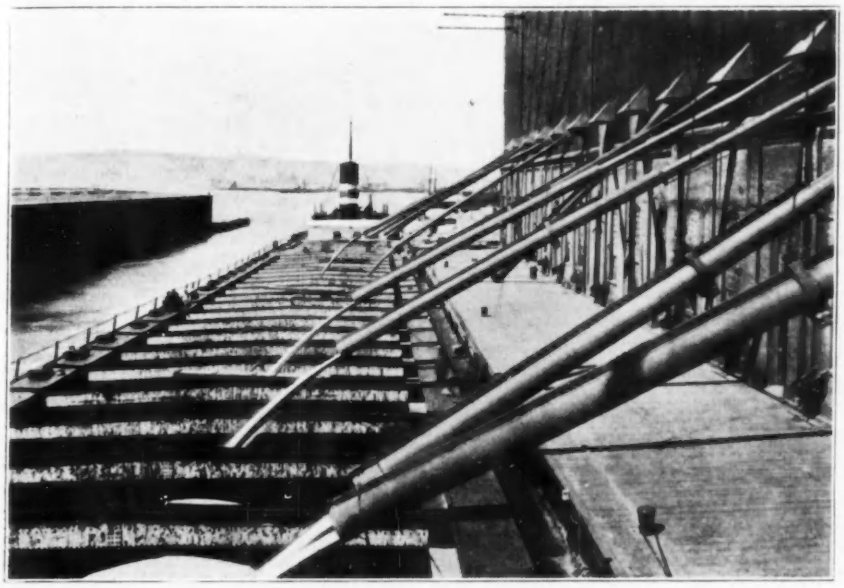
North American Great Lake Transport Facilities*

The Activities of the United States Corps of Engineers in the Great Lakes Area

Address by Lieut.-Col. W. H. HOLCOMBE, C.E.
District Engineer, Milwaukee, before the Annual Convention of the American Association of Port Authorities, October 11th, 1939.

I APPRECIATE very much this opportunity to speak to your Convention regarding the activities of the Corps of Engineers in the Great Lakes area. Briefly, the aims and duties of the Engineer Department in this area have been to construct and maintain the many improvements on the Great Lakes and their connecting waters which Congress has authorised during the last one hundred years or more.

As you are no doubt aware, Congress provides for River and Harbour improvements under its general authority, derived from Article V. of the Constitution, to regulate commerce with foreign nations, among the several states, and with Indian tribes. Congress has charged the Chief of Engineers, under the general direction of the Secretary of War, with the responsibility for this work.



Loading Grain at Elevator "S" at Duluth-Superior, Minn. and Wis.

The Chief of Engineers is in charge of the Corps of Engineers and the Engineer Department. The Corps of Engineers consists of the officers and enlisted men of the Engineer branch of the Army. The Engineer Department consists of the civilian engineers and other civilian assistants who, under supervision of officers of the Corps of Engineers, are engaged on River and Harbour work.

Directly under the Chief of Engineers is the Board of Engineers for Rivers and Harbours. This Board, which normally holds its sessions in Washington, is composed of seven of the senior officers of the Corps of Engineers who have had wide experience in River and Harbour matters. This Board acts in an advisory capacity to the Chief of Engineers on questions relating to the improvement of Rivers and Harbours. I will mention its functions a little later.

For the purpose of administering River and Harbour activities throughout the country, the United States is divided territorially into eleven areas called "divisions." There are five divisions on our sea coasts, five divisions on the great river systems in the interior of the country, and the Great Lakes Division, with which we are more directly concerned this morning.

Each of these divisions is in charge of an experienced officer of the Corps of Engineers, usually of the grade of Colonel, who as Division Engineer is responsible for all River and Harbour Work within his division. Each division is sub-divided into several districts, each under a District Engineer selected from the officers of the Corps of Engineers. A district usually comprises one or more drainage areas or parts thereof. The Great Lakes Division is composed of five districts with headquarters at Duluth, Milwaukee, Chicago, Detroit and Buffalo.

*Reproduced by permission of the U.S. War Department with photographs supplied by Colonel Holcombe and the map by Major-General U. S. Grant.

Development of Cargo Movement

What has been accomplished in the way of River and Harbour Improvements on the Great Lakes can be best brought out perhaps if we devote a moment to considering the development and growth of commerce which these improvements have served and helped to make possible. Less than a hundred years ago, inter-lake commerce to Lake Superior and Lake Ontario was impossible except by discharging cargoes from ships on one lake and transporting them overland for reloading on other ships. In the case of transits between Lake Huron and Lake Erie it was necessary to unload parts of the cargoes on to lighters in order that the ships might negotiate the shallows in the St. Clair River and Lake St. Clair.

In 1850 about 6,000 tons, including the first shipment of iron ore, was moved from Lake Superior to lower lake ports. In 1937 about 87,500,000 tons of freight passed through the St. Mary's Falls Canal which now connects Lakes Superior and Huron.

I recently saw a statement comparing Great Lakes commerce with the commerce of the United States ocean-going merchant fleet in 1937. It was interesting to note that American vessels engaged in coastwise and inter-coastal trade carried about 125 million tons of cargo, which was about double the tonnage carried by American vessels in foreign trade. American vessels on the Great Lakes also carried about 125 million tons of cargo. As the Great Lakes are open for only eight months of the year, except for a limited amount of car-ferry traffic, it appears that while tonnage carried by American lake vessels in 1937 was about two-thirds of the tonnage carried during the twelve month period by American ocean-going vessels engaged in both foreign and coastwise trade, the lake tonnage carried by American vessels approximately equalled the tonnage carried during the same period by the entire ocean-going fleet of American merchant ships.

It is interesting to note also that a list of the twenty-four largest ports of the United States on the basis of tonnage contains twelve sea ports and twelve Great Lake ports. And as a final comparison of lake commerce and ocean commerce, the tonnage transported annually through the St. Mary's Falls Canal at Sault Ste. Marie is greater than the combined tonnage of the Panama, Suez and Manchester Ship Canals. It is said that if the ships passing through the Detroit River in 1937 had been equally spaced both upbound and downbound during the entire season, a commercial vessel would have passed the foot of Woodward Avenue, Detroit, every fifteen minutes in one direction or the other from the beginning of navigation in the spring until its close in December.

While comparable in volume, there is much of contrast between Great Lakes and Ocean commerce. Great Lakes and Ocean Shipping are competitive to only a very minor degree. Through navigation between the lakes and the ocean is limited, by locks in the canals which pass the rapids of the St. Lawrence River, to ships of 254-ft. length, 44-ft. beam and 14-ft. draft. Great Lakes shipping is a specialised trade and Great Lakes ships and docks are specialised to meet that trade. Over 95% of Great Lakes commerce is made up of bulk commodities and special loading and unloading facilities both ashore and afloat have been developed for handling these bulk shipments. The more important of these commodities comprise in order of tonnage—iron ore, coal, limestone and grain, with lesser quantities of petroleum products, sand, gravel, cement, lumber, pulpwood, scrap iron, and salt. Automobiles and general merchandise complete the list of items.

Influence of Transportation on Industrial Development

The contribution of the transportation system of the Great Lakes to the industrial development of America can hardly be over-estimated. The history of one is the history of the other. Great Lakes transportation has joined iron ore of the Lake Superior district with coal of Pennsylvania, West Virginia and Ohio in the making of iron and steel. It has provided the

North American Great Lake Transport Facilities—continued

farmer of the North-west with economical transportation to the consuming centres and exporting cities of the East, and it has supplied the railroads, industries, and homes of the North-west with coal mined 1,000 miles away. All this has been done by Great Lakes bulk-freight vessels at an average cost of less than one mill per ton-mile for the transportation, and at an annual cost to the United States of about one-sixth of a mill per ton-mile for federal improvements, based on traffic, handled in 1937.

This record has been made possible by two principal factors, improvement by the United States of the harbours and connecting channels of the Great Lakes to keep abreast with ever-increasing demands for facilities to accommodate larger and larger vessels; and development by shippers, railroads and other interests of special loading and unloading facilities which are considered the best in the world for the purpose for which they are used.

Car Unloader—Baltimore and Ohio Railroad Coal Dock, Port of Lorain, Ohio.

Iron Ore Handling

A typical dock for loading iron ore into vessels consists of a group of elevated pockets into which the ore can be dumped from railroad cars, and from which the ore may be discharged through trap doors and chutes into the holds of vessels. Several ships can load simultaneously along both sides of the larger ore docks. A typical Great Lakes bulk freighter has its bridge and deck-crew quarters forward, with its boiler and engine rooms and engineers' quarters aft. Amidship is a continuous hold with hatches athwartship, fairly standard in width and spaced to meet the requirements of the ore docks and other standardised loading and unloading devices on the Great Lakes. At the lower lake ports, the ore is unloaded by grapple buckets to railroad cars or stock piles on the docks. A typical ore vessel, carrying ten or twelve thousand tons is usually loaded in two or three hours, and may be unloaded in four to six hours. It is said that in one experimental operation, under most favourable conditions, 12,500 tons of ore were loaded in 16½ minutes.

Coal Handling

The soft coal cargoes are almost all loaded at Lake Erie ports, the greater part being shipped to Lake Michigan and Lake Superior. A typical arrangement for transferring soft coal from railroad car to vessel consists of a car dumper, by means of which coal cars of any capacity are picked up, inverted, and emptied into a hopper from which the coal is discharged through chutes into the hold of the vessel. The cars are usually segregated on certain tracks in the yard and run to the dumper by gravity when the time for loading the vessel arrives. The capacity of the dumpers ranges from 20 to 50 cars per hour. At the upper lake ports the coal is transferred from vessels to cars or storage by clam-shell buckets and bridge cranes; 14,000 tons of coal have been loaded in five hours and unloaded in about ten hours.

Stone Handling

Stone is loaded either by means of belt conveyors from storage piles to the vessel or by chutes from elevated pockets in the manner used for loading iron ore. Unloading of stone is accomplished in part with buckets in a manner similar to the practice for iron ore or coal. Stone handling has also produced the self-unloader, a Great Lakes innovation. This type of ship can go almost anywhere and discharge its cargo. Dock facilities are not needed. Wherever depth of water allows it can sidle up to a bank and, with outstretched boom, can place its cargo of stone or coal at any spot desired. At present there are 36 lake vessels which are capable of self-unloading. The stone loading record on the Great Lakes is said to be 10,000 tons per hour and the stone unloading record by a self-unloaded is almost 3,000 tons per hour.

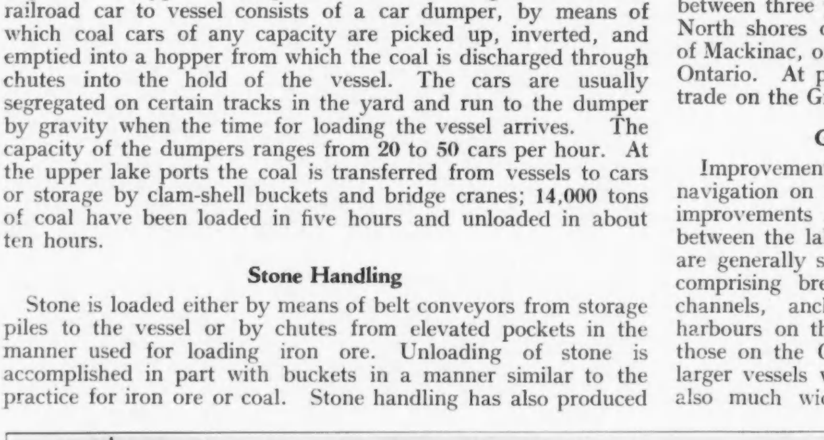
Grain Handling

Grain is loaded from elevators to the holds of vessels by chutes and is unloaded by suction. The average rate of loading is said to be something over 50,000 bushels per hour, and the average rate of unloading slightly less than 25,000 bushels per hour.

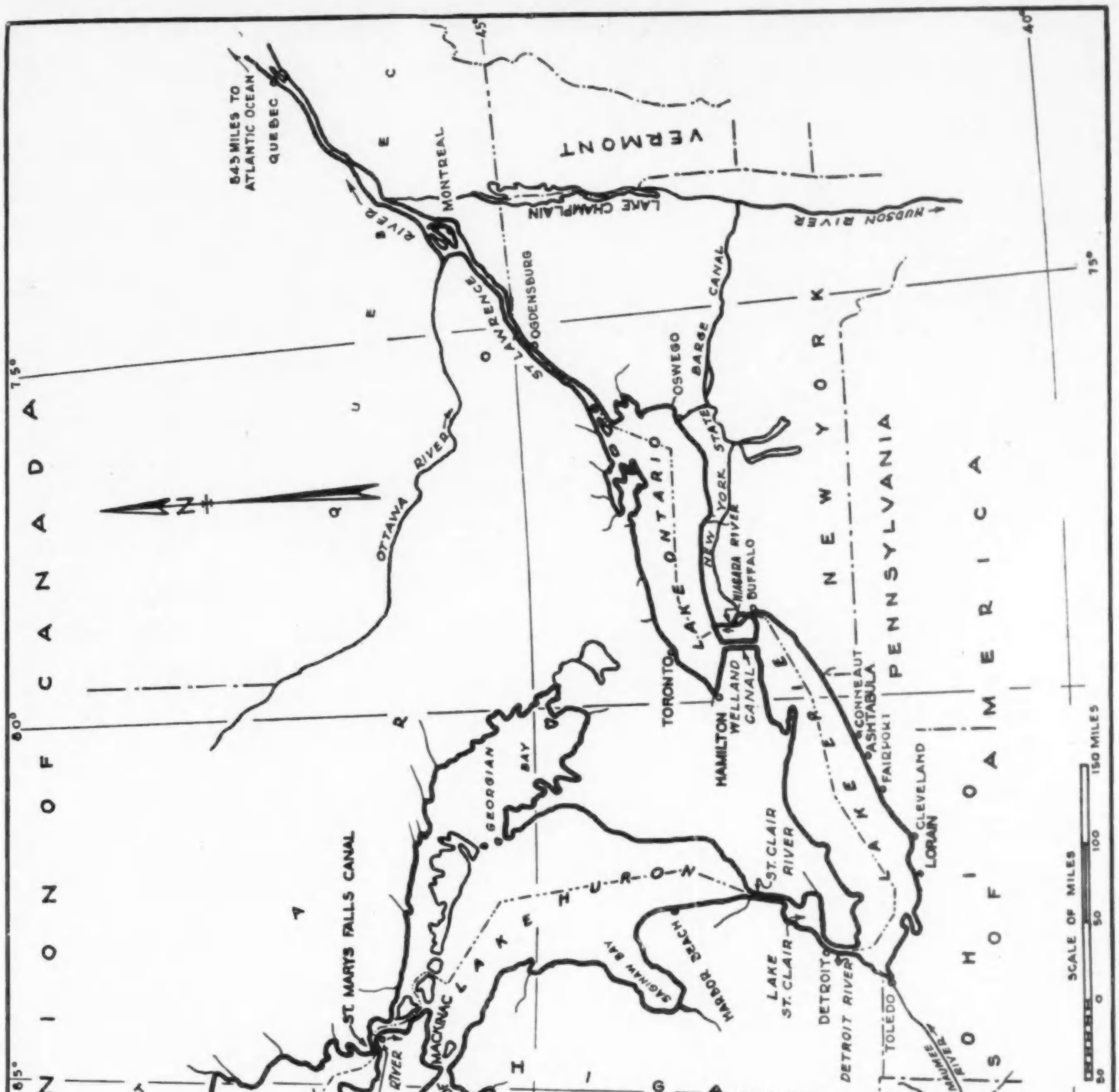
Not the least noteworthy of the Great Lakes specialities is the car ferry. These ships, up to 390-ft. long and 64-ft. beam, are equipped with four tracks under their decks, to which 20 to 30 freight cars can be shunted and taken off without difficulty. On Lake Michigan alone, the car-ferry service is the most extensive in the world, operations being conducted by three railroads between three ports on the East and five ports on the West and North shores of the lake. Other ferries operate at the Straits of Mackinac, on the Detroit River, across Lake Erie and on Lake Ontario. At present there are about 27 vessels in the car-ferry trade on the Great Lakes.

Great Lake Harbour Improvements

Improvements by the United States in the interest of navigation on the Great Lakes consist generally of harbour improvements and improvement of the connecting channels between the lakes. Harbour improvements on the Great Lakes are generally similar in character to those on the sea coasts, comprising breakwaters, piers and revetments, and dredged channels, anchorage basins and turning basins. However, harbours on the oceans are necessarily larger and deeper than those on the Great Lakes, because of the larger seas and the larger vessels with deeper draft. Ocean harbour entrances are also much wider than those on the lakes, because of the larger boats and seas, and also in order that the tides may pass without creating excessive velocity of current and erosion. Protective structures for ocean ports are also more massive than those on the lakes because of the heavier seas. Do not however, get the impression that Great Lakes storms are not of great intensity. During a North-east gale in the fall of 1929, several reinforced concrete caissons, each 54-ft. long and having net weight of about 1,000 tons on the stone foundation, were dislodged from the South breakwater at Milwaukee Harbour. There are various other similar cases of damage to structures by storms on Lake Michigan as well as on the other lakes. Although the Great Lakes have relatively less natural harbour protection than the ocean, their fresh water simplifies the work of constructing the piers and breakwaters required at almost every port. While stone is the principal material available for breakwater construction on the ocean, because of the teredo and the destruc-



Self-unloading Bulk Freighter "Alpena."



THE GREAT LAKES OF NORTH AMERICA

North American Great Lake Transport Facilities—continued

Locks at St. Mary's Falls Canal, Sault Ste. Marie, Mich.

tive characteristics of salt water, stone, timber, wood piling, reinforced concrete, and steel sheet piling are all used advantageously on the lakes according to availability and cost at the various localities. Because of the general lack of natural protection and the consequent need for many harbour improvements, it is fortunate that harbour construction on the Great Lakes is relatively less expensive than on the ocean. There are eleven improved U.S. harbours on Lake Superior, thirty-eight on Lake Michigan, five on Lake Huron, sixteen on Lake Erie and six on Lake Ontario.

Connecting Channels

The principal works of improvement by the United States in the connecting channels of the Great Lakes are the St. Mary's Falls Canal at Sault Ste. Marie, Mich., between Lakes Superior and Huron, and the channels in the St. Clair River, Lake St. Clair, and the Detroit River, connecting Lakes Huron and Erie. Improvement works by the Dominion of Canada include the Canadian Lock at Sault Ste. Marie, Ontario, and the Welland Canal, a few miles West of Niagara Falls, which connects Lakes Erie and Ontario. As heretofore mentioned, there are also improvements of the St. Lawrence River, by the Canadian Government, which include the removal of shoals and the provision of canals around the St. Lawrence rapids with locks accommodating ships up to 254-ft. in length and 14-ft. draft.

The first successful attempt to overcome the obstacle of the Falls in the St. Mary's River was made by the North-west Fur Company in 1797-98 by building a canal on the Canadian side to

Bridge Crane unloading vessel at Wisconsin Electric Power Company's Coal Dock, Port Washington, Wis. Capacity of Crane 600 tons per hour.

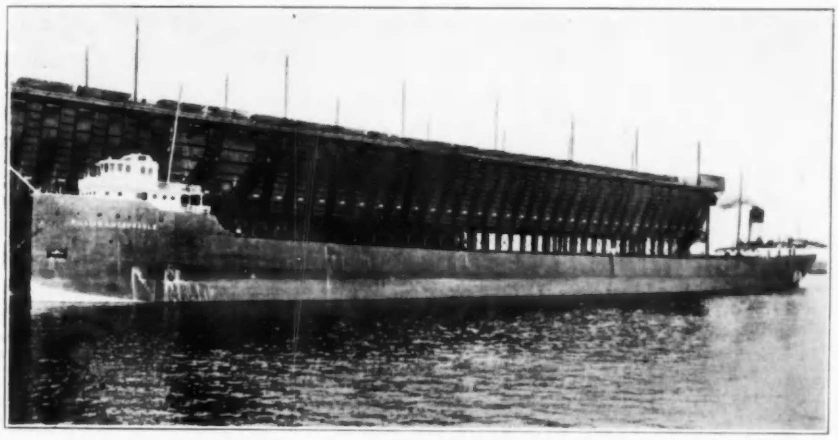
North American Great Lake Transport Facilities—*continued*

afford navigation by small boats and rafts. This canal was destroyed during the War of 1812, and until 1855, movement of freight around the falls was overland. The locks now in operation at the " Soo," three on the American side and one on the Canadian side, are among the largest locks in the world.

The American Davis and Fourth Locks, completed in 1914 and 1919 respectively, are identical, being 1,350-ft. long and 80-ft. wide with controlling depth of 23.1-ft. at present low water datum. They can now take in tandem lockage two of the largest lake vessels in service with about 100-ft. to spare.

The American Poe Lock and the Canadian lock, completed about 1895-6, though smaller than the Davis and Fourth locks, are in active operation. A fourth American lock, completed in 1881, is now too small for most vessels passing the St. Mary's River and has been out of commission since 1918.

Deepening and widening of the channels in the St. Mary's River, through shoals of sand, clay, boulders, sandstone and limestone rock, have been in progress continuously for over 40 years, so that a minimum depth below present low water datum of 24-ft. is now available for downbound, and 20.6-ft. for upbound traffic. The dredged channels total 46 miles in length, with minimum widths of 300-ft. for one-way traffic and 600-ft. for two-way traffic.



Steamer "William A. McGonagle," at Duluth-Superior Ore Dock.

The Straits of Mackinac is the connecting Link between Lake Michigan and Lake Huron and is used by all vessels navigating to and from Lake Michigan. It is about 5 miles wide and has ample natural depth. It is crossed by car ferries and also by the fleet of automobile and truck ferries operated by the Michigan State Highway Commission. Service is continuous throughout the year.

The natural depth of water in Lake Huron has been sufficient for all traffic on the Great Lakes except for a length of about 5 miles at the lower end of the lake which has been improved to a depth of 24.9-ft. below present low water datum for a least channel width of 800-ft.

The St. Clair River connects Lake Huron and Lake St. Clair and has a total fall of 5.2-ft. in its length of 40 miles. The river has two characteristic sections, the upper or normal channel about 27 miles long, and the lower or delta portion, commonly known as the St. Clair Flats. The width of the upper section of the river averages about 2,000-ft. The most important branch in the delta section, which is used for through navigation, is known as the South Channel. The Corps of Engineers has improved channels at various localities to secure a depth of 25-ft. and least width of 600-ft. for downbound traffic, and an upbound channel with depth of 21-ft. and least width of 450-ft.

Lake St. Clair is an expansive shallow basin of about 460 square miles area with maximum natural depth of about 21-ft. The United States has provided a channel across the lake, 18 miles long and generally 800-ft. wide, with a depth of 25-ft. below present low water datum.

The Detroit River, connecting Lake St. Clair and Lake Erie, has a length of about 31 miles with width varying from one-half mile to about 3 miles. The upper 9 miles of the river is generally unbroken in cross section, the water being generally deep and the current velocity about 1½ miles per hour. The southerly or lower river broadens out and is characterised by many islands and shallow expanses, the bottom consisting generally of earth and boulders with the exception of a length of about 6 miles at Lime Kiln Crossing where the bottom is mainly bed rock and boulders. In its original condition the river was navigable throughout its entire length, but the shoals in the rock section at Lime Kiln Crossing limited the usable depth to 12½ to 15-ft.

The Detroit River has been progressively improved from 1874 to 1936. By far the greatest part of the project has been the excavation of the Livingstone and Amherstburg Channels through the rock section. An interesting feature of the work was the excavation of the Livingstone Channel, in the " dry," behind the largest coffer dams ever constructed, which were built of rock and clay excavated from other sections of the channel. About 6 miles of this channel was excavated through limestone rock, the face in some areas being over 12-ft.

The project for Detroit River provides for a two-way channel from Lake St. Clair to the head of Livingstone Channel, with a minimum depth of 25-ft. and least width of 600-ft.; the downbound Livingstone Channel with minimum depth of 26-ft. and least width of 450-ft.; the upbound Amherstburg Channel with minimum depth of 21-ft. and least width of 600-ft.; and a two-way channel from the lower junction of the Livingstone and Amherstburg Channels with a minimum depth of 26-ft. and least width of 1,200-ft. to deep water in Lake Erie.

Welland Ship Canal

The present Welland Ship Canal, which overcomes the barrier to traffic between Lake Erie and Lake Ontario formed by Niagara Falls, was constructed by the Dominion of Canada during the years 1913-1933. It provides for passage of vessels of 700-ft. length, 75-ft. beam, and 23.5-ft. permissible draft. There are eight locks, comprising one guard lock and seven lift locks. The lifts vary from about 44 to 48-ft., aggregating 327-ft. total lift. Three of the locks are twin locks overcoming the steep rise known as the Niagara escarpment, and permitting uninterrupted passage of upbound and downbound traffic.

Lake Survey

An activity of the Corps of Engineers on the Great Lakes which I have not yet mentioned is the United States Lake Survey. This office, with headquarters at Detroit, is responsible, under the Division Engineer of the Great Lakes Division, for surveying and charting the Great Lakes and their harbours and connecting channels, and for making investigations and studies of all data affecting the levels of the lakes. The Lake Survey issues over a hundred maps and charts, and also annual bulletins with monthly supplements, giving complete information necessary to successful navigation of the Great Lakes. The services which the U.S. Coast and Geodetic Survey furnishes for navigation of our sea coasts are provided by the U.S. Lake Survey for navigation on the Great Lakes.

Development Procedure.

In conclusion, may I say a few words regarding the procedure followed by the Engineer Department in reporting upon and recommending to Congress the approval or rejection of desired improvements in the interest of navigation?

The first step in securing such an improvement is for the citizens interested to arrange with their senators or representatives in Congress to secure its inclusion in the River and Harbour Act, requiring that a preliminary examination and survey of the locality be made, to ascertain the facilities existing, the present and probable future needs, and the most satisfactory method of caring for these needs. After the act has become a law, the task of making the examination is allotted to the District Engineer in whose district the desired improvement is located. By correspondence with local officials and others interested, a date is set for a public hearing for the purpose of affording all interested parties an opportunity to express their ideas and desires as to what improvements are needed. The notice of the scheduled hearing is widely circulated by letter, newspaper announcements, and other means in an effort to notify all who may be interested so that all concerned may be given an opportunity to be present and to express themselves. Those unable to be present are invited to express their views by letter, these letters being read at the hearing and becoming a part of the record of the hearing.

The hearing is attended by the District Engineer, who acts as chairman, and by the citizens who are interested. A stenographer is present to transcribe a verbatim record of all that takes place and to record the names of all who attend. An opportunity is afforded all present to present their views and recommendations regarding the desired improvements in as great detail as they may desire. The object of the hearing is to get information, and actual facts and figures are desired. The data presented should be complete, definite, and accurate to be of value, since favourable action must be based entirely on facts and figures as they are presented at the hearing or as they are obtained from other sources. An improvement, before it can be recommended, must be justified by economic conditions as they exist or as they can reasonably be assumed for the future.

North American Great Lake Transport Facilities—continued

Following the hearing, the preliminary examination report is prepared in the district office. This report considers all facts that have been presented at the public hearing, together with such additional data bearing on the matter as may be available. It contains a statement of the improvements requested by local interests, with a discussion of their desirability, a resumé and discussion of all known factors bearing on the question, and a definite recommendation by the District Engineer as to what, in his opinion, the action of the Federal Government should be on the request.

Toledo, Ohio. Ore Machine unloading the "Shaughnessy" at Chesapeake and Ohio, Railroad Dock, East side, Maumee River, Presque Isle. Capacity of unloading, 10,000 tons in 4 hours.

With the complete record of the public hearing as an enclosure, this preliminary examination report is forwarded to the Division Engineer. Should the Division Engineer recommended adversely on the request, he so states in his endorsement, giving his reasons therefor, and notifying all interested parties by letter of his adverse finding, with the information that interested parties may request a hearing before the Board of Engineers for Rivers and Harbours at Washington for the purpose of presenting such additional data as they may desire. Should the Division Engineer recommend favourably in his report, no notice of his action is sent those interested. The examination report and endorsement are then forwarded to the Chief of Engineers who transmits them to the Board of Engineers for Rivers and Harbours for their consideration and recommendation.

If the action of the Division Engineer was adverse, the Board notifies those interested of the date, time, and place of the hearing by the Board if one has been requested. Stenographic report of this hearing is also made and becomes an enclosure to the report, which is then forwarded by the Board to the Chief of Engineers, with the recommendation of the Board. The Chief of Engineers, in turn, considers the report, enclosures, and all endorsements thereto and forwards it to the Congress with his recommendation. Congress may, of course, order a survey to be made, in spite of adverse reports from the various department officers, but it has been found that Congress seldom does so.

If the action of the Division Engineer is favourable, all papers are forwarded, as above, to the Chief of Engineers and by him to the Board. Should the action of the Board be unfavourable, notices to that effect are sent to all interested parties, with notification that a hearing before the Board may be held, if desired, and the procedure thereafter is as I have already outlined.

Should action by all reporting officers be favourable, indicating that the improvement is necessary and desirable, the Chief of Engineers orders the District office to make a survey report. This report includes an investigation of the cost of the improvement and a recommendation as to whether a specific plan should be adopted. The survey report is concurred in, or disapproved by, the Division Office and the Board, as heretofore explained, and is finally transmitted to Congress by the Chief of Engineers. If the report is favourable to the desired improvement, Congress then orders it to be printed in the form of a Congressional Document, and this then becomes, after adoption by Congress, the approved project for that locality. Congress, in an appropriation act, provides funds which the Chief of Engineers may allot, to be expended as he sees fit in carrying on the new work authorised under projects adopted one year or more in the past, subject to such limitations as Congress may specifically include in the Act.

Notable Port Personalities

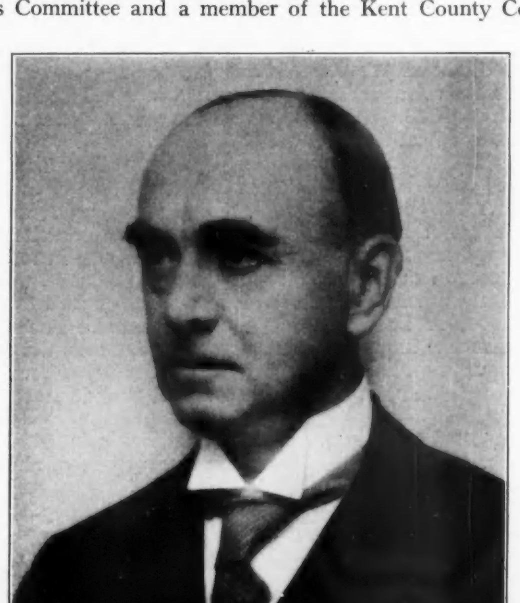
II.—Sir David J. Owen

Sir David Owen, son of the late Revd. R. Ceinwenydd Owen, of Liverpool, retired from the position of General Manager of the Port of London Authority in 1938. He was educated at the Liverpool Institute and in his 'teens entered the office of the General Manager and Secretary of the Mersey Docks and Harbour Board. He served there until the year 1904 when he went to Messrs. Paul Brothers, Flour Millers, of Liverpool and Birkenhead, as their manager.

In 1908 he was appointed Assistant Manager of the Goole Docks which belong to the Aire and Calder Navigation, and he became the manager of those docks in 1914. In the following year he was appointed Secretary to the Belfast Harbour Commissioners, soon afterwards being made General Manager and Secretary. In 1922, he was offered and accepted the position of General Manager of the Port of London Authority, which he held for 16 years. The Port of London Authority, since their creation in 1908, had made several experiments in the method of management of their undertaking, each one of which was not of long duration, and it was not until Sir David's appointment as General Manager that stability was reached. He was able to reorganise the administration and to effect considerable economies in the working, with the resultant effect of enabling the port charges to be reduced from their former high level.

Sir David engaged in many other activities during his service with the Port of London Authority. For some years he was chairman of the London Port Employers, a member of and Treasurer to the National Council of Port Labour Employers, a member of the Executive Committee of the Dock and Harbour Authorities' Association, and a member of the Beckenham Borough Council. He was President of the National Employers' Confederation, 1936-37; President of the Institute of Transport, 1932-33; a member of the Royal Commission on Lotteries and Betting, 1932-33; a member of the Special Government Committee on Holidays with Pay, 1937-38; and Chairman of the Board of Trade Merchant Shipping Reserve Advisory Committee, 1939. He was knighted by His Majesty the King in 1931.

In addition to his membership of the National Employers' Confederation, and the Institute of Transport, Sir David is also Chairman of the Anglesey and Caernarvonshire Agricultural Wages Committee and a member of the Kent County Council.



Sir DAVID J. OWEN, M.Inst.T.

He has published several works, including "A Short History of the Port of Belfast," 1917; "History of Belfast," 1921; "The Port of London Yesterday and To-day," 1927; and "The Origin and Development of the Ports of the United Kingdom," 1939.

Insectile Infestation of Grain

A Serious Port Storage Problem

At the request of the grain trade and with its assistance and financial support, the Department of Scientific and Industrial Research has just compiled and issued a Report* on the extent to which stored grain is infested by insects. It is a document which must command the earnest attention of port officials.

The Report states that infestation by insects is to be found in docks, farms, merchants' premises—in fact, throughout the whole chain of transport and storage. These insects are not natives of the British Isles, but were, and still are, brought in with grain and other produce; and, although they cannot live and breed in this climate on our crops or corn stacks in the field, they do thrive in barns, granaries, warehouses and mills.

After brief descriptions, illustrated with photographs and drawings, of the most important species of insects which attack grain in store and of the part played by mites, the report shows how insects, once landed at the ports, are distributed right through the country. The links in this chain of distribution, i.e., dock premises, transport vehicles and containers, mills and agricultural merchants' premises, seed merchants, farms, breweries, maltings and distilleries are all dealt with in turn. A diagram illustrating the movements of grain shows how home-grown grain, which is free of insects when harvested, can become infested on the farm.

The prominent position of ports in the chain of transport renders it essential that the infestation evil should be combatted and, as far as possible checked, at this converging point in the distribution of foodstuffs from abroad. The vital necessity of concerted action on the part of port authorities to this end becomes evident from a consideration of the following extract from the Report:—

" The **Port,** as the centre for the distribution of grain and cereal products coming from overseas, is equally a centre for the distribution of any insects occurring in them. There is ample evidence of this, and it is noteworthy that insects which are not native to this country are found frequently by entomologists in warehouses at ports or in goods just delivered from them, and then, it may be years later, are found in warehouses inland, or even in the larders of private houses. What happens is that foreign insects gradually become established in the ports and from them spread and become established in the country generally. In so far as grain-infesting insects are concerned, it may truly be said that, while at one time a marked distinction might have been drawn between the kinds and numbers of insects found in the warehouses at the ports and those found in warehouses inland, that distinction is now of no importance.

" Cereals and cereal products arriving at the ports may be distributed immediately, or they may be stored for a short period, or, as more frequently happens, grain may undergo treatment in the flour or provender mills which are now so marked a feature of the dockland landscape.

Transit Sheds

" Goods remain in transit sheds only for short periods, not usually exceeding a fortnight. At all times a great variety of commodities is housed and, although they may remain there only for a very short time, there is every opportunity for a transference of insects from one commodity to another. For example, large numbers of copra-beetle (*Necrobia rufipes* De G.) were observed on ground-nut cake in one shed, and later it was found that some of them had crawled on to casks of tobacco and other commodities. In the same port all offals and meals were stored in the same shed. In this there were large quantities of badly infested goods, harbouring the spider-beetles, *Ptinus tectus* Boiel, and *Ptinus fur* L., the flour-beetle *Tribolium castaneum* Hbst., and the moth *Tinea granella* L. It is certain that any goods placed in this shed, even for a short time, would become infested with these insects.

" Transit sheds are generally so constructed that proper cleaning and disinfestation are difficult and, although the modern sheds are better in this respect, the constant influx of infested goods makes it difficult to keep them free from infestation. This can at present be done only by disinfestation of the goods before storage.

General Warehouses

" Goods may lie in dock warehouses for varying periods of time, even for a number of years. Little is done, either by the public or the private warehousemen, to segregate various classes of goods (e.g., grain, offals, and manufactured feeding stuffs), or to isolate infested consignments. The warehouses are usually congested with goods piled against the walls and with very little space between the stacks; this leads to difficulty in cleaning and hampers the receipt and issue of goods in any proper sequence. Goods may thus be overlooked and opportunity afforded for insects to multiply without disturbance. In a northern port, a warehouse was examined where goods, which had been stored for only a few days, were badly infested with the beetles, *Tribolium castaneum, Ptinus tectus, Silvanus surinamensis,* L., and the moths, *Ephestia elutella* Hb., and *Borkhausenia pseudospretella Stt.* In this warehouse several sacks of maize-germ meal, Scots wheatfeed, and bran had been kept for two years, and were heavily infested with large numbers of these insects. Prolonged storage of these cereal products also leads to the rapid multiplication and spread of mites, which, once established, are very difficult to eradicate. In another warehouse in the same port the goods were stacked clear of the wall with plenty of space between, and sweeping was a daily routine; no rubbish sweepings or old sacks were left lying about. Although the same classes of goods were stored here, no insects were found.

Grain Weevils.

" Many warehouses are old, ill-lit and have wooden floors with numerous cracks and holes. Generally they have many years' accumulation of dirt and grain dust in which the resident population of insects maintains itself. Rats and mice break open sacks and packages and spill the contents. This leads to the accumulation of grain and cereal refuse round the stacks, and this may also be carried into the fabric of the building by rats and mice. The population of insects resident in general warehouses is similar to that found in bulk-grain warehouses and described below.

Granaries.

(1) Bulk-grain Warehouses.

" The grain in bulk-grain warehouses is stored on floors, being delivered by chutes after elevation to the top of the building. In contrast to storage in silos, the grain is stored so that its height above floor level varies from four to twenty feet, exposing a large surface. The gain is kept in place either by bulkhead boards or by sacks filled with the grain.

" The bulkhead boards have a large resident population of insects in the cracks and holes in the wood and in the sacking joining them together. The commonest insects found here and also in the fabric of the buildings themselves are: *Calandra granaria* L., and *C. oryzae* L., the spider-beetles *Ptinus tectus* Boiel. and *Niptus hololeucus* Fald., the beetles, *Attagenus pellio* L. and *Tenebrio molitor* L., and the moths, *Borkhausenia pseudopretella Stt. Endrosis lacteella* Schiff., and *Ephestia elutella* Hb. Bulkhead boards are used repeatedly without any cleaning. The spaces between the sacks filled with grain that are used to keep the pile in place are a favourite hiding-place for many insects, especially the beetles *Ptinus tectus, Tribolium castaneum, Tribolium confusum* Duv., *Caiandra granaria, Calandra oryzae,* and *Tenebrioides mauritanicus.*

" Insects can maintain themselves in the fabric of a building for a long time. This is especially true of the spider-beetles *Ptinus tectus,* which are often found in empty warehouses and are capable of maintaining themselves for a considerable time at a low level of numbers and rapidly multiplying when given another supply of suitable foodstuffs. These beetles are found in large numbers in bulked grain only when it is stored on floors.

" Where a large surface of grain is exposed, the outer layers tend to become very moist, thereby providing excellent conditions for the multiplication of insects. Such conditions are also

*" Report on a Survey of the Infestation of Grain by Insects." by Professor J. W. Munro, D.Sc., pp. 54, with diagrams and illustrations. Published by H.M. Stationery Office. Price 1s. 3d. (By Post 1s. 5d.).
Extracts and illustrations reproduced by permission of the Controller of H.M. Stationery Office.

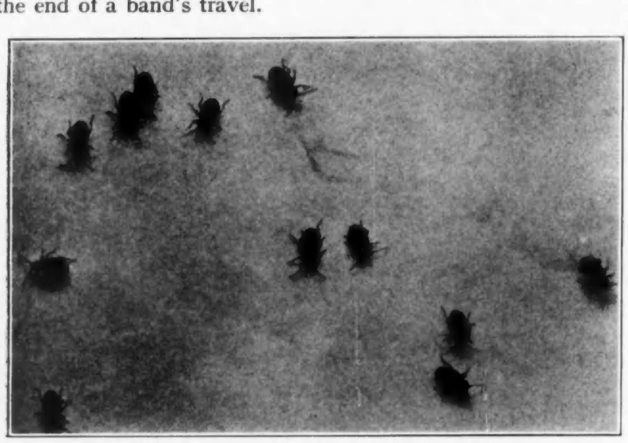
Insectile Infestation of Grain—continued

favourable for the rapid development of mites. Usually no facilities exist in bulk-grain warehouses either for screening or for turning grain which has become heated owing to the presence of insects or mites and, as there are no means of segregating infested grain, one badly infested consignment introduced into a warehouse may lead to infestation of all other grain in store.

"There is rarely any cleaning beyond an occasional sweeping, and these warehouses are usually very dusty and dirty, with the windows covered with old cobwebs. The warehouses of one port authority in the north-west of England are regularly cleaned by a powerful vacuum-cleaner fitted with attachments for cleaning the ceilings and walls. Although this is effective in removing loose dust or grains and undoubtedly reduces infestation, it does not dislodge insects or cocoons lying in cracks or crevices.

(2) Silos.

"In silos the grain is stored in bins of various capacities, up to about 250 tons; all bins, with the exception of chimney-bins, extend for the whole height of the silo, and have the common characteristic that the depth is much greater than the cross-section; the surface exposed is, therefore, small. The grain is elevated, and after passing over screens and being aspirated to remove foreign materials, such as small stones, sand, and dust, is carried on conveyor-bands and discharged into a manhole in the top of the bin. This manhole is kept covered, except when the grain requires ventilation. There is very little chance for insects to travel by their own efforts from one bin to another, and an infested consignment is automatically segregated when once in the bin, except in wooden silos in which the tops of the bins are covered by a false floor. Occasionally, however, insects are thrown off the conveyor-bands, together with light dust, and may find their way into a bin. This is especially true of bins at the end of a band's travel.



Spider Beetles (Ptinus).

"Most of the modern silos are equipped with built-in thermometers at various depths in the bins, by means of which the condition of the grain is checked daily. In the older silos the temperatures are taken by means of hand-operated spear-thermometers which penetrate the grain only to a depth of about 20-ft. at the most. Similar spear-thermometers are used in bulk-grain warehouses. Grain which is found to be heating can be readily turned or revolved and, if necessary, can be screened to remove insects. It should, however, be noted that screening will remove only free-living insects and the adults, but not the eggs, grubs, or caterpillars of those which develop within the grain in the immature stages (e.g., the beetle *Calandra* and the moth *Sitotroga*).

"The more recently constructed silos are built of concrete, which provides a smooth surface on the inside of the bin. The older silos are constructed of brick or wood; laminated-wood silos are common in flour mills. The walls of these brick and wood bins provide innumerable cracks and crevices in which grain and insects are lodged. It is possible for a resident population to maintain itself for a very long time by feeding on this grain. In a very exposed northern port, some bins in a wooden silo which had been empty for ten or twelve months, and had previously held Plate and African maize, contained large numbers of live beetles, namely, *Calandra granaria, C. oryzae. Tribolium castaneum, Silvanus surinamensis, Rhizopertha dominica* F., *Tenebrioides mauritanicus*, and two species of *Laemophlaeus*. The cleaning of brick and wooden bins is much more difficult than that of concrete bins, which are said to be self-cleaning. Except for the use of long-handled brushes, operated from the top and the bottom of the bin, no regular cleaning of any type of bin was seen.

"The constant working of grain through the top floor of the silo throws up large quantities of dust in which all stages of insects and mites are present. This dust is swept up at intervals; it may be removed by suction-traps in the floors of modern silos, but, although it seems incredible, is more often swept into the most convenient bin.

"The following data, obtained from the examination of the various consignments in the port warehouses and granaries seen during the survey, indicate the extent and nature of the infestation under the three main methods of storage. Of 3,316 consignments seen, 46 per cent. were infested, mainly with *Calandra* weevils, the next most important insect being the beetle *Ptinus tectus*. The infestation was distributed as follows: silos 31 per cent., bagged grain 59 per cent., and bulk grain 75 per cent. In the general warehouses at the ports, 65 per cent. of the consignments of feeding-stuffs were infested, and in the mill warehouses 60 per cent.

"At the ports, as the evidence of the survey shows, the grain-weevils account for the greatest part of the infestation of consignments from all countries except India. When it is remembered that these weevils are primary pests and lay the grain open to attack by insects of secondary importance, the damage done by weevils at the ports is evidently serious. It is worth noting that in modern silos, properly managed, infestation may be low. The main sources of infestation are Indian rice-bran and Australian wheat, both of which are badly infested on arrival."

Remedial Measures

While it is hard even to guess at the vast amount of damage done by these enemies which prey on the nation's food supply, the first line of defence against them is the commonsense rule of health—scrupulous cleanliness and separation of the infested from the healthy. Obviously if the loss and inconvenience caused to industry was becoming intolerable in normal conditions it cannot be tolerated when every effort must be made to avoid waste of our food supply and the publication of this report is a timely warning of the risk we have to meet. A review of a companion Report on Insecticide in Warehouses was published in the July issue of this Journal.

The present Report includes a declaration made by representatives of many sections of industry that since all concerned must share the responsibility for infestation, good commercial practice requires every section of industry to treat infestation as a "notifiable disease" and so make possible the segregation of infested goods.

The Port of Hong-Kong

Appointment of Special Adviser

Sir David Owen, lately General Manager of the Port of London Authority, has accepted an invitation from the Government of Hong-Kong, through the Colonial Office, to visit the Colony for the purpose of advising upon the future administration of the Port and he is expected to leave the country during September.

The terms of reference which he has been given are as follows: "To investigate the whole question of harbour facilities, organisation and administration at Hong Kong, having regard to the existing system of pier leases which are due to expire in about 10 years' time, and, in the light of physical, economic and political conditions, to make recommendations for measures by which the Port could in future be developed and controlled to the best advantage of all persons and interests dependent on its services."

It is understood that the port facilities at Hong-Kong are now provided by private enterprise, but the ground, on which the piers, etc., have been constructed, is the property of the Government, who originally granted leases for long terms to private companies. These leases, as stated above, are due to expire in about 10 years, and the Government of the Colony have intimated that they are not likely to renew them. The question, therefore, arises as to how the port should be controlled and administered in the future, and the whole subject of development is suspended until the matter of port control is settled. One suggestion has been made that a Port Trust should be created. These are the matters which Sir David will look into. He is admirably qualified for the task, his whole business life having been spent in port work as will be seen in the biographical sketch which appears elsewhere in this issue.

Sir David is to be accompanied by Mr. Duncan Kennedy, M.Inst.C.E., who will act as his Engineering Adviser. Mr. Kennedy has just returned from the Port of Beira, Portuguese East Africa, where he has been acting as Resident Engineer, on behalf of Messrs. C. S. Meik & Halcrow, the Engineers for that port, on the construction of deep water berths for shipping, which have been described in past issues of this Journal. Previously he was Resident Engineer for Messrs. Rendel, Palmer and Tritton on the construction of Chelsea Bridge and before that for five years as Sectional Engineer on the London Royal Docks Approaches improvement scheme. He has also had experience in harbour construction works in India and on other engineering undertakings in Canada and Egypt.

Notes of the Month

Port of Bombay Trust.

The Government of India have appointed Major-General the Hon. T. P. P. Butler, D.S.O., as a representative on the Board of the Bombay Port Trust in place of Brigadier W. A. K. Fraser, C.B.E., D.S.O., M.V.O., M.C., who has resigned.

Recommissioning of Dry Dock at Cardiff.

The Bute West Graving Dock No. 1, at Cardiff, formerly owned by the Hills Dry Dock and Engineering Company, Ltd., and subsequently by Thomas Diamond and Co., Ltd., has just been recommissioned after a long period of closure on account of lack of business.

New Slipway at Puerto Cabello.

A new type of marine slipway, with a capacity of 500 metric tons has been completed for the naval arsenal at Puerto Cabello, Venezuela. Known as the "Crandall" type, it has a length of 111.7 metres of rail track, the length of Cradle being 43.5 metres. It is electrically operated.

American Association of Port Authorities.

The 29th Annual Convention of the American Association of Port Authorities is to be held at the Port of Long Beach, California, from September 10th to September 14th. The President of the Association is Mr. Alex. J. Crothers, of Camden, New Jersey. Mr. Tiley S. McChesney, of New Orleans, Louisiana, is Secretary-Treasurer.

New Port in Portuguese East Africa.

A new port is in course of construction at Nacala in Portuguese East Africa. Nacala is at present a natural harbour with deep water anchorage, about 20 miles from Lumbo, South of Mozambique. Surveys have been completed and piling operations are in progress. A railway will be laid from Nacala to connect with the Mozambique-Nyasaland line.

Progress of Port Registration Schemes.

In answer to a question in the House of Commons, Mr. Ernest Bevin, Minister of Labour, stated that since the Dock Labour (Compulsory Registration) Order was made on June 18th, 30 committees had submitted schemes for approval which had been given in 16 cases. He added that there are approximately 40 ports in which it will be desirable to establish registration schemes.

War-time Fatalities among Dock Workers.

The General Executive Council of the Transport and General Workers' Union have passed a resolution paying tribute to the sacrifice of their members employed at the docks in certain areas of the country as a result of enemy action, coupled with an expression of sympathy with the relatives of the men, who, with their comrades, were in the front line of attack.

Abandonment of Canal Dock in London.

The Grand Union Canal Company has been authorised under a warrant from the Ministry of Transport to abandon a section of the canal in the Borough of St. Pancras, comprising the Cumberland Arm and Basin, which extends from the Canal Cut to the main Regent's Park section. Under present conditions, the dock has become redundant and is no longer required. The main line Canal is not affected by the decision.

Southampton Dock Jubilee Year.

July 26th last marked the fiftieth anniversary of the opening by Queen Victoria of the Empress Dock at Southampton, which was constructed by the former Southampton Dock Company with the aid of a loan of £250,000 from the London and South Western Railway Company, both of which bodies have since been incorporated in the Southern Railway Company. The dock, which has a depth of 26-ft., has been used of recent years by the Royal Mail Steam Packet Company in connection with the South American Meat Trade.

Arctic Shipping Route.

Ports on the Soviet Arctic Shipping Route along the Northern Coast of Siberia are expanding their trading operations. Vessels formerly making the return journey in ballast are now increasingly finding cargoes, particularly coal, which this year is being shipped from Arctic ports in large quantities. The Sangara Mines on the River Lena, the Norilsk Mines on the Yenisei and the Ziryansk Mines on the Kolymer not only produce coal sufficient for all vessels plying in Arctic waters, but they are capable of supplying the needs of neighbouring districts as well. Moreover, new coal deposits are being discovered and it is expected that in the future there will be large fuel shipments to more distant industrial regions.

Increase of Port Rates at London.

As from August 1st, the rates and charges of the Port of London Authority have been increased, generally within a limit of 5 per cent. Similar increases have also been made by the London Association of Public Wharfingers.

The Dnieper-Bug Canal.

The Dnieper-Bug Canal, linking the Black Sea and the Baltic through the medium of the two rivers named, has now been declared open to traffic. It forms part of a waterway which extends for 900 miles through Poland and Soviet Russia.

The Port of Whangarei, N.Z.

At the annual meeting of the Whangarei Harbour Board, Mr. E. L. Whimp, the chairman announced a credit balance of £4,066 at the end of the financial year. During the twelve months, imports decreased by 8,238 tons, but exports rose by 19,026 tons.

Canadian National Harbours Board.

Mr. R. K. Smith has been appointed chairman of the Canadian National Harbours Board in succession to Mr. R. O. Campney. Mr. Smith was formerly Director of Marine Services in the Canadian Department of Transport.

Death of Former Harbour Master.

Captain James B. Leask, formerly superintendent harbour master and dock master at South Docks, Sunderland, died at the age of 77 at the end of July. He was appointed dock master in 1895 and subsequently promoted to the harbour mastership. He had lived in retirement since 1930.

New Grain Elevator at Rosario.

The large new grain terminal elevator at the Port of Rosario, with a capacity of 75,000 tons, is well advanced, and its construction is expected to be completed before the close of 1941. The site is reclaimed land, which has necessitated careful preparation of the foundations for the structure.

The New Graving Dock at Sydney.

Boring operations are now in hand in the harbour of Sydney, N.S.W., to provide the requisite information about the foundation strata for the new graving dock authorised by the Australian Government to be constructed between Pott's Point on the East side of Woollormooloo Bay and Garden Island. Sir Alexander Gibb has been appointed consulting engineer for the scheme.

The Expansion of Dairen Harbour.

An expansion project for the harbour of Dairen (Dalny) in Korea, has undergone some modification due to difficulty in obtaining constructional materials. The amended scheme, estimated to cost 90 million yen, includes the reclamation of about 1,700,000 square metres of land along the Hsingluchiao and the construction of three piers, all expected to be completed by 1946.

Port Appointment.

Following the retirement of Mr. E. W. Gould, announced in our last issue, Mr. R. Dixon has been appointed Manager of the Great Western Railway Company's Docks at Plymouth. Like his predecessor, Mr. Dixon started his career with the Alexandra, Newport and South Wales Docks Company. During service in the Chief Dock Manager's Office at Cardiff, he became head of the Commercial Section, which deals with the whole of the Great Western docks system.

New Passenger Pier at New York.

Pier No. 64 at the foot of West Twenty-Fourth Street, New York, U.S.A., has recently been completed and put into commission. It occupies the site of old piers, Nos. 63 and 64, and has been designed for the use of the Government-owned Panama Line. The new structure comprises a pier with double storey superstructure, 510-ft. long by about 100-ft. wide. The approximate cost of the undertaking, including a return "bulkhead" building 362-ft. by 46-ft., has been $1,333,000.

Mersey Docks and Harbour Board.

At a recent meeting of the Mersey Docks and Harbour Board electors, the following were elected to be the commissioners for auditing the accounts of the Board for the next three years:—Colonel A. C. Tod; Major L. H. Cripps; Messrs. A. K. Barnes, E. Enfield Fletcher, S. J. Lister, F. H. Lowe, W. R. Roberts, C. E. Torrey, F. R. Verdon, H. C. Walker, Alfred Woods and D. Warwick Williams.

An Order-in-Council has been made postponing the next election of elective members of the Board until December, 1943, and extending the existing term of membership of all elective members for three years.

The Construction of Jetties

An Article for Students

By STANLEY C. BAILEY, Assoc.M.Inst.C.E., F.G.S.

THE following article deals with the construction of jetties suitable for merchant ships to lie alongside for loading or discharging their cargoes. Such jetties are usually in more or less sheltered positions inside harbours, wet docks, and wide navigable rivers; while others, such as those used for the shipment of ores and phosphates, are occasionally situated in bays, and are thus much more exposed to the actions of winds and rough seas. When there are a number of jetties, or piers, in harbours, they should be arranged parallel to one another, and normal to, or at a suitable angle to a wharf opposite the harbour entrance, so that the minimum amount of turning will be necessary for a ship to berth; and they should be so placed that there is no jetty immediately opposite the entrance, to avoid heavy waves and ground swell coming into the harbour.

There should be at least from 1,000 to 1,500-ft. clear water space between the outer ends of the jetties and the breakwater to enable vessels to be turned easily into their berths alongside the jetties.

An area in the harbour and clear of the jetties, from 1,500 to 2,000-ft. in diameter, will be required as a turning circle, and for swinging the ships to enable compasses to be tested. For this latter purpose, a central mooring buoy will be required, attached by a cable chain to ground moorings. The diameter of the turning circle should be, at least, twice the length of the longest ship using the port.

The water space allowed between jetties varies considerably in different ports, and ranges between 200 and 820-ft., but the more usual distances are from 200 to 600-ft.; while the width of the piers ranges from 85 to 800-ft., but the usual widths to provide for transit sheds, crane roads and railways are from 200 to 400-ft. The lengths range from 600 to 3,700-ft., depending upon the space available in the harbour, but the more usual lengths are from 1,500 to 2,000-ft.

The depth of water alongside the piers at L.W.S.T. depends upon the maximum loaded draught of ships using the port, plus 2 to 3-ft. between the keel of the ship and the sea bed.

The live load provided for on piers or jetties, exclusive of the weights of cranes and railway goods wagons, varies from 2 to 5 cwts. per sq. ft., although some have been designed for 10 cwts. and even 1 ton per sq. ft.

Types of Jetties

The sketches Figs. 1 to 16, show cross sections of jetties, and are given to illustrate the various types of construction and scantlings which have actually been used, but the sections are not those of existing jetties, and where only one bay is shown in width, this of course can be multiplied, according to the width of the jetty required to provide for transit sheds, etc.

Some piers are of the solid or wharf wall type, being constructed as shown by Fig. 1, with two side walls at a certain distance apart, and a cross wall at the head, with rubble stone and earth filling between, while the surface of the ground at coping level is covered with either, macadam, concrete or wood block paving, or with granite setts. This type of jetty is the most suitable in cases where large vessels and heavy cargoes have to be dealt with, and where ample space is required for transit sheds with heavy floor loads of 10 cwts. per sq. ft. heavy crane loads, and railways sidings.

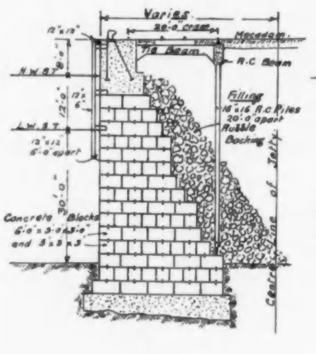


Fig. 1.

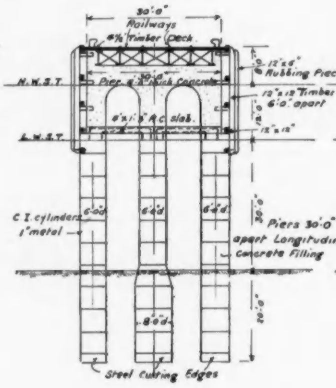


Fig. 2.

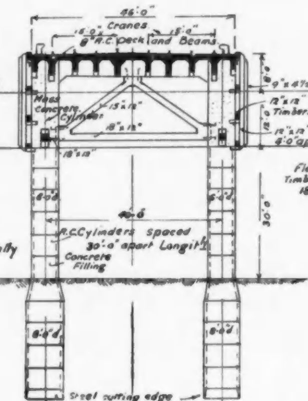


Fig. 3.

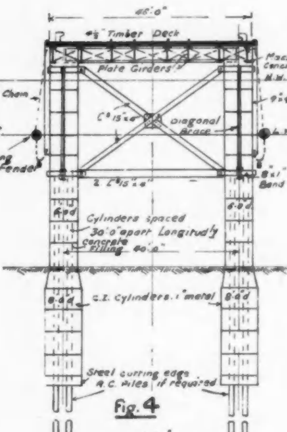


Fig. 4

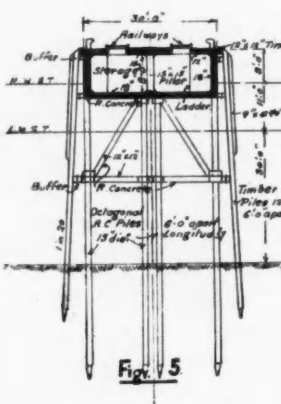


Fig. 5

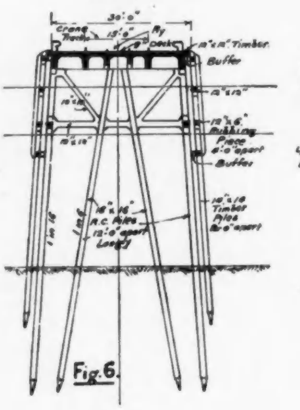


Fig. 6.

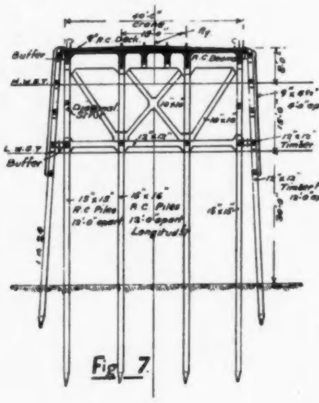


Fig. 7

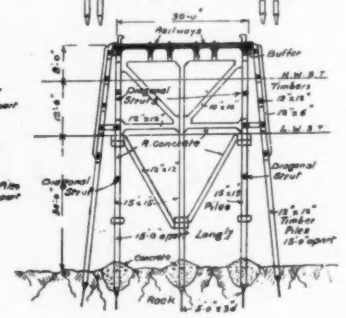


Fig. 8

In Canada, and the United States of America, where timber is plentiful, such jetty walls are often formed of timber crib-work floated out to the site of the wall, where they are sunk by filling them with rubble stones, up to above L.W.N.T. level, the superstructure being constructed of mass concrete.

The construction of solid masonry or concrete walls involves the excavation of deep trenches inside a timber built cofferdam, the space inside the cofferdam being pumped out, and the work executed in the dry. To avoid this, the walls, as shown in Fig. 1 may be constructed of concrete blocks in the proportion of 1-2-4; these may be of any convenient size according to the crane plant available.

Suitable sizes are 5-ft. by 3-ft. by 3-ft. and 6-ft. by 3-ft. by 3-ft. Such blocks will weight about 2.8 to 3.4 tons each, and can be handled by a 5-ton crane. By using two sizes of blocks, they can be so laid that they will break joint with one another in each course. The blocks are prevented from sliding on one another by inserting vertical dowels in the horizontal joints of each block, the dowels consisting of granite, or concrete reinforced with a steel rod; they are usually 12 inches long and 4 inches in diameter or square, fitting into pre-made holes 6-in. deep in the blocks. A trench is first dredged on the line of the wall, and filled with concrete by means of a tremie or closed tube reaching from the bottom to the water surface, or by

The Construction of Jetties—continued

means of a closed skip or bucket having a hinged bottom. The work of spreading and levelling the concrete, and of laying the concrete blocks is carried out by divers.

One advantage of solid jetties is, that as the tide rises and falls, there are no cross currents or ground swells as in open piers, and therefore no tendency for vessels to pull out from the jetty, and ships on the lee side are sheltered from the wind during storms.

There is also little scour except at the heads of the jetties, but there is always silting up in the water spaces between the piers at the shore ends, which entails dredging at intervals.

Another form of wall which involves no under water work, with the exception of the concrete foundation, is of the buttress type, and consists of rectangular or square reinforced concrete caissons, which are built on shore, slid down a slipway into the water, and towed out to the site of the wall, where they are filled with concrete and large stones by means of a crane mounted on a lighter, and thus sunk in position on to an already prepared concrete bed on the line of the wall, leaving a clear space of from 15 to 20-ft. between each caisson.

The tops of the caissons are usually above L.W.N.T. level, and water which enters above the tops at high tide, is pumped out before continuing the concrete filling.

On two sides of each caisson there are grooves about 1-ft. from the face to receive reinforced concrete slabs about 2-ft. deep and 15 to 18-in. thick, weighing from 3½ to 4 tons each, these are dropped down in the grooves between the caisson, thus forming a wall.

On the tops of the caissons similar reinforced concrete slabs are laid, and a mass concrete wall is erected on these up to coping level. In this type of wall, as the loads from the backing and filling are concentrated on the caissons, it is necessary that the concrete foundation should be thick to spread the weights over the sea bed between the caissons.

The amount of steel reinforcement in the slabs may be varied according to their depth below coping level in about 4 stages, the slabs being marked according to their position in the wall.

The backing to the walls should be of stone rubble to reduce the pressure, and the filling should consist of rubble stone, mixed with shale and earth. In some of these piers, the central portion for a width of 22-ft. (to allow for two lines of railways) is sunk about 2-ft. 6-in. below coping level to enable goods to be transferred from the transit sheds on each side direct to the floor level of the trucks, and in others the floors of the sheds are ramped up for the same purpose.

Cylinder Sinking

Figs. 2, 3 and 4 illustrate the construction of jetties when cast iron, mild steel, or reinforced concrete cylinders are used to support the superstructure.

To sink these cylinders in position, it is first necessary to construct a piled timber staging of 4 or more piles round the site of each cylinder, with a platform on top for a crane, and the gear for sinking purposes. The sections of the cylinder are brought by a barge to the site, assembled on the platform, and lowered by means of steel rods or links attached to the bottom section by hooks, the rods terminating at the platform in long screws working in screw jacks, or through the hubs of 3 hand-wheels, arranged round the circumference of the opening for the cylinder.

Another method is to use long links with drilled or slotted holes in them at intervals of about 9-in. The links are attached by pins to the ends of the crosshead of a vertical hydraulic ram having a stroke of 9-in., the rods projecting several feet above the ram, which is fixed in the middle of two channel beams, several inches apart, that lie alongside the opening for the cylinder in the platform, and the links pass between the channels which have holes drilled in their webs for pins that go through the hole in the links, there being three or four rams round the circumference. When lowering the cylinder, the pins through the channels are removed; the rams carrying the cylinder are lowered 9-in., and the pins are reinserted in the channels, then the pins in the crosshead are taken out, the rams raised 9-in., and the crosshead pins refixed, and so the process is repeated until the cylinder reaches the sea bed, when the gear can be disconnected.

The sinking of the cylinder is continued by excavating the ground in the interior by means of a grab from the crane, with the assistance of some tons of cast iron kentledge placed round the top of the cylinder, or slung from the top on the outside.

In London clay the sinking can frequently be carried out in the dry after the cylinder has penetrated it for several feet, the water having been previously pumped out.

When the sinking to the required depth or stratum has been completed, the bottom is plugged with 1-2-4 concrete about 4-ft. thick, care being taken that the weight of the kentledge is such that there will be no tendency for the cylinder to rise by floatation.

The concrete for the interior of the cylinder, if deposited in the dry, may be in the proportions of 1-2½-5 or 1-3-6, but if carried out in the water should be at least 1-2-4, deposited by means of a tremie or by skips having hinged bottom doors.

In Figs. 2 and 4, cast iron cylinders are shown in 5-ft. lengths, which is a convenient length, they should not be less than 5-ft. diameter when working space for a grab is required, and up to 6-ft. diameter they may be in simple rings, but above this size, the rings are usually in two or more sections, with interior flanged joints bolted together, although cylinders from 15 to 21-ft. diameter and about 5-ft. high have been cast in single rings for piers.

The thickness of metal varies between 1-in. and 1¼-in., and when mild steel cylinders are used, the metal is usually ½-in. to ⅝-in. thick, with interior flanges formed of angles, and T steel stiffeners at vertical joints. The mild steel cutting edges in each case consist of a 12-in. to 24-in. curved plate from 1-in. to 1¼-in. thick, sometimes with a bevelled cutting edge. The diameter of the cylinders at the bottom depends upon the maximum load per sq. ft. that the ground will support, and in some cases diameters of 10 and 12-ft. are required.

The change from a large to a smaller diameter should not be made when possible much below the sea bed, otherwise there will be trouble in sinking the cylinders which will tend to get out of the vertical on account of the looseness of the soil above the larger diameter.

The top length of cylinders is generally a making up length, and will required to be specially cast.

Before deciding on the adoption of cylinders, borings should be made to ascertain the character of the strata, so that a definite sinking depth can be determined beforehand.

In Fig. 2 the superstructure above the cylinders consists of a reinforced concrete slab 4-ft. wide and 1-ft. 3-in. thick, to tie them together, on which is built a mass concrete pier 4-ft. thick, to carry the steel beams and the decking.

In Fig. 3 reinforced concrete cylinders are shown, they are usually constructed in lengths of from 5 to 10-ft. on shore, and from 5 to 6-in. thick. The joints are generally of the spigot and socket type with ¾-in. diameter projecting rods screwed at the ends in each section, and connected by a right and left hand screwed union, the rods being arranged round the circumference opposite one another in interior pockets. Another method is to have two rods projecting at intervals in the lower section about 4-in. apart, and a single rod in the upper section between these, the rods passing through holes in a metal plate, and screwed by nuts; or flat bars 2½-in. by ⅝-in. may be used, these being arranged to just miss one another round the circumference, and are connected together by bolts. When cylinders are made with butt joints, a groove 2-in. diameter is formed in each of the meeting surfaces and filled with sausage shaped bags of 1 to 1 cement mortar just before the sections are joined together, and the projecting rods connected.

The cylinders when sunk are filled with concrete, the upper portions consisting of mass concrete piers 6-ft. in diameter, with reinforced concrete beams and decking. The reinforced concrete "A" frames may be constructed on shore and placed in position by a crane.

Oil fuel pipes, water mains, and electric cables, are usually slung under the decking with openings having hinged covers in the deck for the necessary pipe valves where required.

In Fig. 4, the cast iron cylinders are shown to be sunk in mud and silt, and to give more support to them, after the excavation by grabs has been completed, reinforced concrete or timber piles are driven down inside before they are filled with concrete through a tube.

The cylinders are braced together longitudinally and transversely by steel channels, attached to the cylinders by steel bands.

Timber decks are usually of creosoted redwood planks 7-in., 9-in., or 11-in. wide and from 3 to 6-in. thick, laid transversely on the jetty, and there should be a clear space of about ½-in. between each plank. Railway and crane rails are usually carried direct on longitudinal hard wood sleepers laid on the girders with the tops of the rails level with, or just above the decking, the edges of the planks being protected from the flanges of the wheels of the rolling stock by steel angles.

Fenders.

The timber walings and fenders are generally of creosoted redwood or pitch pine, and the rubbing pieces of elm, the latter should be fixed by compressed oak trenails 1-in. in diameter, and at about 18-in. pitch, arranged zig-zag, as these rubbers are liable to be torn off by vessels, projecting iron rails are objectionable.

The lower ends of the rubbing pieces, and fenders, should always be protected by a longitudinal waling fixed on the inside, to prevent ropes and hawsers being caught by them.

In some cases, chiefly in tropical ports, the fenders consist of long floating tree trunks as shown in the sketch (Fig. 4) from 18-in. to 2-ft. in diameter.

At each end of the trunk there is a hole 3-in. in diameter with an iron ferrule, through which a galvanised short link

The Construction of Jetties—continued

chain passes, this is fixed to the coping of the jetty, and at a point below L.W.S.T. level, with a weight attached, the fender thus rises and falls with the tide. In lieu of the chains, vertical iron rods $1\frac{1}{4}$-in. to $1\frac{1}{2}$-in. diam. are fixed in similar positions, and short chains pass though the fender terminating in rings through which the rods pass.

Reinforced Concrete Piled Jetties

Fig. 5 shows a type of reinforced concrete jetty suitable for storing coal, ores, ballast, sand, and even oil fuel. It consists of a concrete tank with cross partition walls at intervals as required. Hatches with ladders and ventilators are provided between the railway tracks; and as the loads will be heavy, the piles are spaced 6-ft. apart longitudinally, and two centre piles are shown in each frame, so that all the piles will carry a practically equal load. The reinforced concrete bracing and the struts are constructed on shore, and are on the Considère system, in which the ends of the members are widened, and a hole in the centre of each is left to fit over the piles. Such bracings are usually used with round or octagonal piles, but may also be employed with square ones, if they are accurately driven.

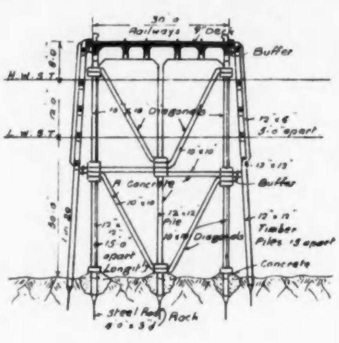


Fig. 9

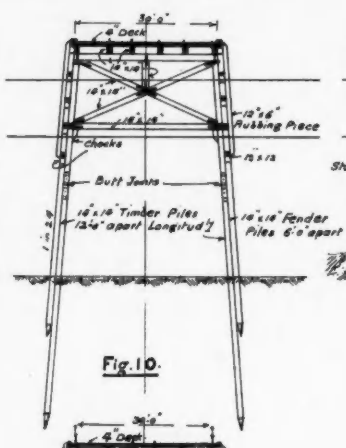


Fig. 10.

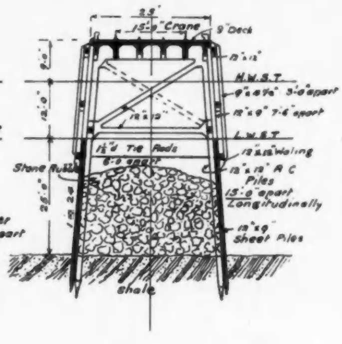


Fig. 11.

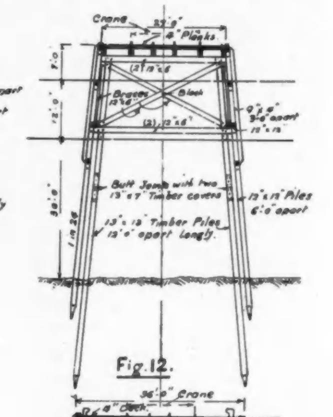


Fig. 12.

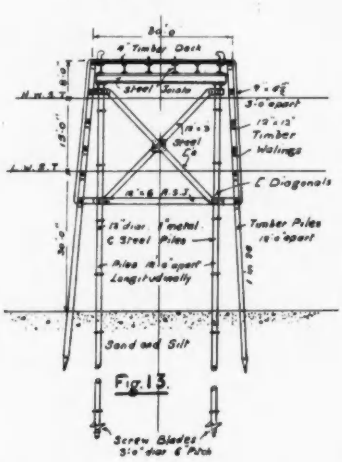


Fig. 13.

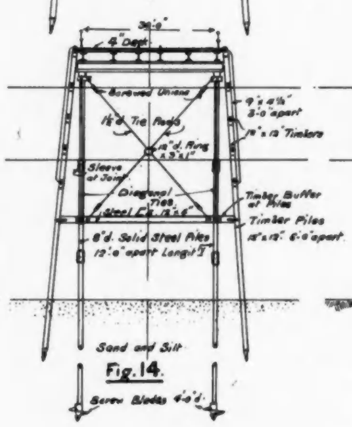


Fig. 14.

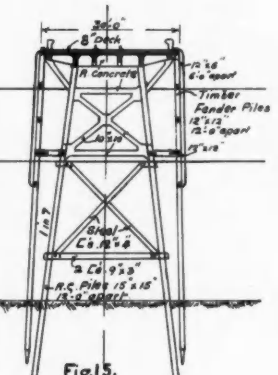


Fig. 15.

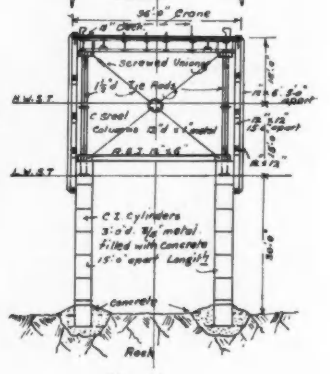


Fig. 16.

The holes are made a few inches larger than the diameter of the pile, and when fitted on the piles in position, hard thick slate and stone wedges are driven at intervals in the space round the pile, which space is then filled with sausage shaped canvas bags filled with 1 to 1 cement mortar. This type of bracing is very suitable for sites where there is a small tidal range, and involves the fixing of the bracing by divers.

The concrete forming the tank should be in the proportions of 1-$1\frac{1}{2}$-$2\frac{3}{4}$ or 1-2-3, and the whole exterior should be coated with bitumen applied hot. Figs. 6 to 9 and 15, illustrate various forms of reinforced concrete jetties, and Figs. 8 and 9 show the methods adopted for fixing the piles in rock by using spiked shoes from 2-ft. by 2-in. diam. to 5-ft. by 3-in. diam. steel rods with chisel shaped points.

Holes are first blasted in the rock, and the piles tapped down, so far as possible, the holes are then filled up with 1-$1\frac{1}{2}$-3 concrete. The concrete for the beams and deck may consist of 1-2-4 cement concrete, the deck having a granolithic concrete finish in the proportion of 1-$1\frac{1}{2}$-3 at least $1\frac{1}{2}$-in. thick deposited at the same time as the bulk of the material.

The outer edges of the deck may be protected by a bull nosed steel plate 4-in. by 4-in. by $\frac{1}{2}$-in. fixed by Lewis bolts, or a timber kerb may be used. Wood blocks should not be used on the decking of jetties because of the trouble caused by their expansion in wet weather. The thickness of the concrete cover over the steelwork in decks should be 1-in., and in beams $1\frac{1}{2}$-in.

Fig. 11 illustrates a reinforced concrete jetty showing the piles driven into shale or shillet so far as possible, and strengthened laterally by sheet piling driven on each side from the level of L.W.S.T. between which there is rubble stone filling. The sheet piles are prevented from spreading by $1\frac{1}{2}$-in. to 2-in. diam. steel tie rods at intervals of about 6-ft. which pass through the walings.

The rubble filling and sheet piles, also serve to cut off cross ground swell, during rough weather, and also the tidal currents from affecting ships lying alongside the jetty.

The reinforced concrete piles used in the construction of jetties range from 14 to 20-in. square, and are sometimes either round or octagonal in the larger sizes. In some cases octagonal piles 20-in. in diam. have been made hollow and have proved satisfactory. The concrete proportions used range from 1-$1\frac{1}{3}$-$2\frac{2}{3}$ to 1-$1\frac{1}{2}$-3 and 1-2-4.

Bollards, Mooring Rings, and Ladders

Mooring bollards which will be required at intervals of from 30 to 60-ft. are generally made of cast iron or cast steel and should be of the hooked type or with arms to prevent the hawsers slipping off, fixed with a cast iron bollard cap with a hole at the top, so that concrete can be poured into the space between the pile and the bollard casing.

Mooring rings of wrought iron from 12-in. to 15-in. internal diameter and from $1\frac{1}{2}$-in. to 3-in. diam. in metal thickness will also be required at intervals along the coping at deck level.

The maximum test load for iron rings which they should sustain without deformation is $W = \frac{1}{4}\ (d)^2$, where W = the load in cwts., and d = diameter of metal in ring in eighths of an inch. The safe load on the ring is taken at $\frac{1}{2}$ the test or proof load.

Vertical iron or steel ladders will also be necessary having 3-in. by $\frac{3}{4}$-in. sides spaced 15-in. apart, with rungs shouldered into the sides at 9-in. pitch, the diameter of the rungs being from $1\frac{1}{8}$-in. to $1\frac{1}{4}$-in.

The ladders are fixed to the top and bottom timber walings, and should not project beyond the faces of the rubbing pieces. Mooring rings, ladders, and portable handrail stanchions with short link chains between should be galvanised.

Timber Jetties

Fig. 10 shows a jetty constructed of timber, and is of a heavy type in which whole timbers are used, the bracing and struts being fixed to the piles by welded straps 4-in. by $\frac{1}{2}$-in. thick, with $1\frac{1}{8}$-in. bolts.

Wooden chocks or angle irons are spiked to the piles to support the members, so that the bolt holes may be accurately bored and the bolts driven. All heads and nuts of bolts bearing directly on the timber should have 4-in. square iron washers from $\frac{1}{2}$-in. to $\frac{5}{8}$-in. thick.

Deck beams should not be spliced at joints over the frames, but should have butt joints with timber or steel fish plates bolted on. Fig. 12 illustrates a lighter type of timber jetty in which half timbers are used in the cross beams, struts, and bracings, which are fixed by bolts only. It is not usual to

The Construction of Jetties—continued

galvanise the bolts and washers used, but it is an advantage to do so.

All timber used in jetties should be well creosoted, and the piles may be of Pitch Pine or Oregon Pine. Other harder woods used are Karri, Jarrah, Ironbark, Quebracho and Greenheart, these are not so liable to be attacked by the marine mollusc *Teredo navalis,* and are not creosoted. Jetties used for the shipment of oil fuel to ships and the shipment of ores in rivers and estuaries, are usually constructed at right angles to the shore, and are built with a strong T shaped head so that the vessels can lie alongside the head in line with the river currents. The leg of the jetty from the shore may be of lighter construction.

For mooring long ships it may be necessary to construct a piled dolphin with a bollard at some distance from each end of the head and in line with it.

Buffers

It is advisable in concrete piled jetties to protect the piles by timber fender piles to receive the blows from vessels, which may push the jetty over so much as 4-in., the pressure on these piles being transmitted to the jetty by buffers situated at the deck level, and also at the horizontal cross struts above L.W.S.T. level.

There are various forms of these buffers, and they usually consist of a cast iron or malleable cast iron socket fixed to the concrete piles, a similar socket is attached to the fender piles on the inside, and between these two sockets, a strong spiral steel spring 8-in. or 9-in. diam. either round in section or flat, similar to those used for railway truck buffers, is inserted.

In some cases one socket is arranged to telescope into the other, and in others there is only one longer socket fixed to the jetty, with a spiral spring coil inside, and fitted with a turned block of wood, with an iron plate bearing against the spring, the outer end of the block being in contact with the fender pile.

Screw Pile Jetties

In Figs. 13 and 14 the construction of jetties in which steel screw piles are used is shown, these are suitable for situations where there are considerable depths of mud, silt, and sand, and the friction on the pile is much reduced.

There are several forms of screw piles, some are of solid steel from 6-in. to 8-in. and 10-in. diam., in lengths of from 20 to 30-ft., which are joined together by a special cast steel sleeve 1-ft. 8-in. long, with 9-in. deep sockets at each end which are hexagonal in shape inside, or have two flat faces, the pile ends being similarly shaped by machine to fit into the sockets, two holes are drilled through each pile end and the sockets for $1\frac{1}{4}$-in. rivets or pins. The screws for these piles consist of a special cast steel socket piece about 2-ft. long, attached to the pile in the same manner as the pile joints. Round this casting one turn of a screw blade from 3-ft. to 4-ft. 6-in. diam. is formed in the casting, having a pitch of 6-in., with a pointed or coarse threaded nose at the bottom. The blades are from 3-in. to 4-in. thick at the base, and from $\frac{1}{2}$-in. to $\frac{3}{4}$-in. thick at the outer edges, which are rounded off on the leading and trailing edges, while most screws have right handed threads.

Others consist of cast steel pipes from 9-in. to 12-in. and 18-in. outside diameter, and from 1-in. to 2-in. thickness of metal, and in 12-ft. lengths, either with outside flanges and bolts, or with spigot and socket screwed joints. Some joints are made with 2-ft. long steel sleeves fitted on the pile ends, and fixed by $1\frac{1}{8}$-in. diam. set screws, twelve at each end.

The screw blades from 4 to 6-ft. diam., and 5-in. thick at the base, with a 6-in. to 8-in. pitch, form a special casting about 3-ft. 6-in. long.

Screw cylinders 2-ft. 6-in. diameter and $1\frac{3}{8}$-in. thick in 12-ft. lengths, with interior flanged and bolted joints have also been made, having two screw threads 5-ft. in diameter at the base, and 5-in. thick next the pile, with a pitch of 10-in., the bottom of the pile being made a cutting edge.

The larger diameter piles have occasionally been filled with concrete to prevent internal corrosion.

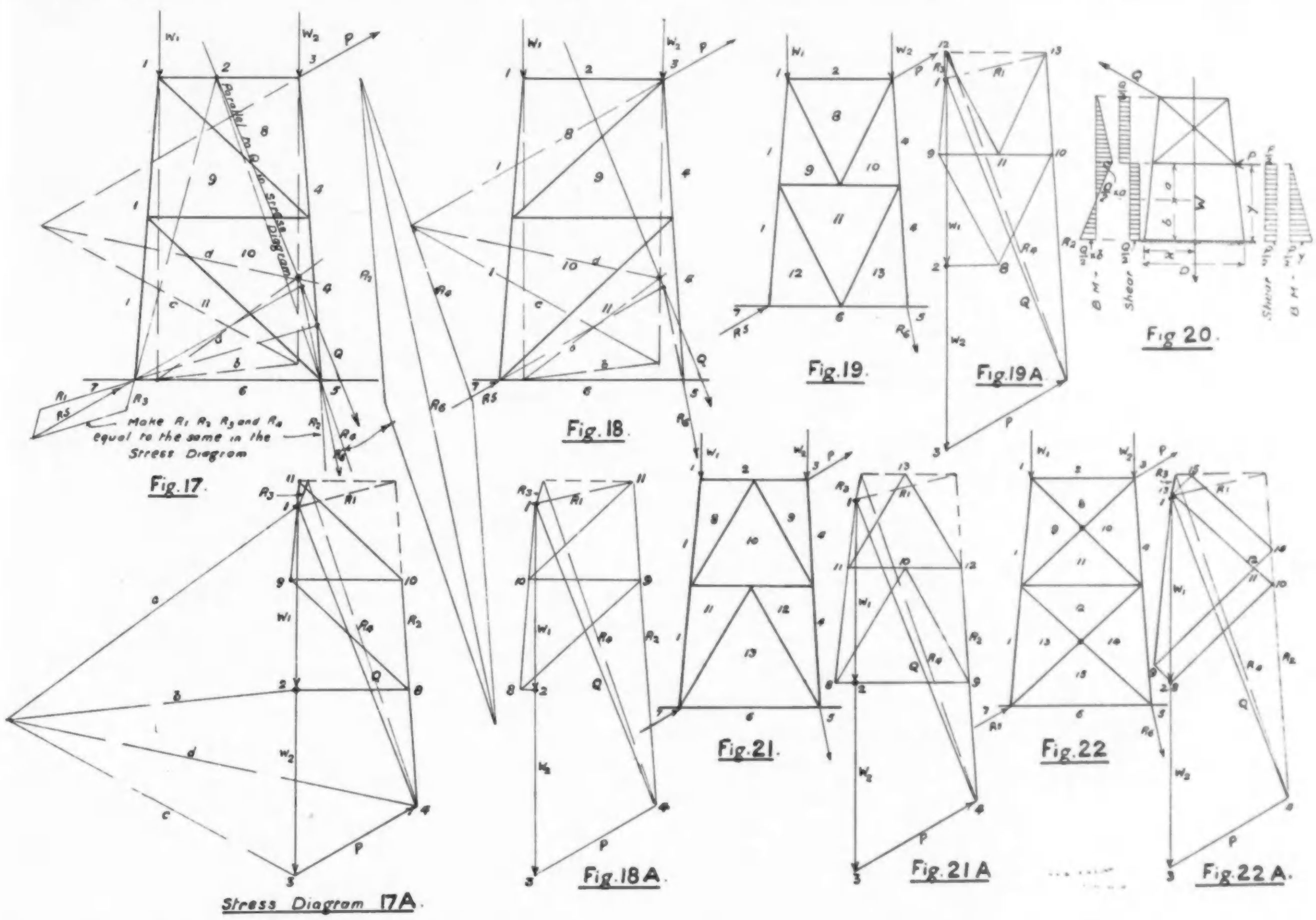
The screwing of piles is sometimes assisted by passing a small pipe through the pile connected to a hole in the shoe, through which water is pumped at a pressure of 150 lbs. per sq. inch.

One turn of a screw blade is sufficient, because if more are given, the space between the blades is liable to become clogged, and the screwing down is more difficult.

The load that can be put on screw piles varies with the bearing capacity of the ground and ranges between 4 and 6.4 tons per sq. ft. of blade area, the latter being equivalent to 100 lbs. per sq. inch.

It is advisable to put a test load on such piles.

With regard to the methods adopted for screwing piles; in the first instance, a timber piled platform is constructed on the site, and with the help of a crane on the platform, or of a floating crane, the pile is passed through a hole in the platform, and a 6 or 8 armed capstan head is clamped to the pile, the 8 or 10-ft. long levers are manned by from 20 to 30 men, who do the screwing, sometimes assisted by a steam winch with an endless rope on the barrel passing round a grooved pulley fixed to the pile, and also by weighting the pile with several tons of kentledge placed in a box on the top, through which the pile passes, the box being held by clamps to the pile. Another method of screwing consists of an hydraulic capstan having two horizontal rams about 9-in. in diameter and 7-in. stroke,



The Construction of Jetties—continued

fitted to the top of the pile opposite one another, pawls on the rams engage with a ratchet wheel attached to the pile, the rams working under a pressure of 600 lbs. per sq. in. Two arms of elm about 4-ft. long, opposite one another, are fixed to the casting carrying the rams, and have pulley blocks at the ends with ropes attached to the platform to take the thrust.

A more modern form consists of a steel frame fitted to the pile head, or supported on it by a crane, the frame carries two electric motors which engage through gearing with two worms, which work in a worm wheel fixed to the pile head, the two ends of the frame have pulleys for ropes that are attached to the staging.

The rate of screwing down piles varies according to the strata encountered and ranges from 1 to 2-in., and sometimes to so much as from 3 to 6-in. in depth per minute.

Fig. 16 shows a more rigid type of jetty suitable for a rock foundation consisting of 3-ft. diam. cast iron cylinders, the metal being ¾-in. to 1-in. thick. The cylinders are bedded in concrete in holes blasted in the rock, and are afterwards filled with 1-1½-3 cement concrete. In the upper portions of the cylinders, steel pipes 12-in. diam. with 1-in. thickness of metal are embedded to support the superstructure.

Figs. 17 to 22 illustrate graphic methods for the calculations of the stresses in the framework of jetties that have several forms of bracing, and are self explanatory. The diagrams provide for the weight of the jetty and the loads on it, in addition to the pull of the hawser on a bollard, which may amount to from 20 to 30 tons or even more.

With reference to Fig. 20 the bending moment M on the framework, which is a constrained cantilever, due to a push (P) $= \frac{W.x - P.y}{2}$ and the strain on the piles $= \frac{M}{D}$ Where P is the total lateral pressure on the frame in tons, and D = width of Base.

Should the frame not be constrained by diagonal bracing, then $M = Wx - Py$.

The maximum compression or tension on a pile $= \frac{P.y.}{\frac{I}{x}} \pm N$

Where y = Lever arm in inches. I = Moment of inertia of pile cross section in inch units. x = Lever arm of weight of jetty in inches and N = Normal pressure on pile in tons per sq. inch.

The amount in inches that a pile will compress under a vertical load $= \frac{P.L}{m}$. Where P is the normal pressure in lbs. per sq. inch. L = length in inches, and m = the modulus of elasticity, which for pitch pine = 1,600,000 lbs. per sq. inch; for Oregon pine 1,400,000; for redwood = 1,200,000; and for concrete, which varies according to its composition and age, from 1,600,000 to 3,500,000, but may be taken at 2,000,000, and for steel at 30,000,000.

The unsupported lengths of piles above the sea bed level, and for at least 3-ft. below that level, must be calculated as for columns, subject to a vertical load and also to a lateral load where the bracing begins, due to the blow or pull of a ship.

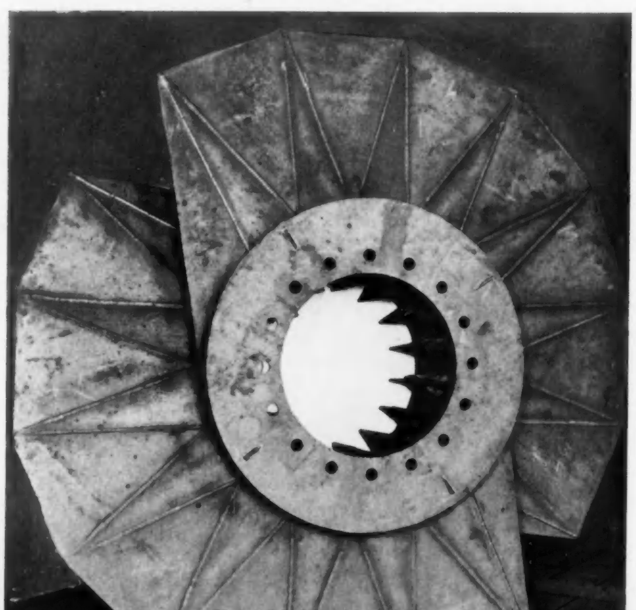
With regard to the impact on the jetty from a vessel striking it, this is very problematical, as it depends so much on the resilence of the jetty to the impact, the greater the elasticity of the structure, the less will be the effect of the blow, and vice versa, but a blow of from 10 to 20 tons per frame should be provided for, that is why timber framed jetties suffer less damage than reinforced concrete structures from the blows of vessels.

The pressure exerted by a vessel on the windward side of a jetty during a storm will be approximately as follows, viz.:—Assuming a ship 300-ft. by 20-ft. above water line, including the superstructure, and a wind pressure of 40 lbs. per sq. ft., this will amount to 107 tons, and allowing for ⅔rds of the length bearing against the jetty, the pressure will amount to 0.53 tons per lin. ft., and with the frames of the jetty 12-ft. apart, the lateral pressure per frame will be 6.36 tons.

A vessel on the lee side will not be much protected from the wind in an open framed jetty, should there be no ship on the windward side, and the pull on the hawsers and bollards at the bow and stem ends will be $\frac{107}{2} = 53.5$ tons, so it is advisable during storms to moor a vessel to two bollards at each end. When pulling a ship into its berth a pull of from 10 to 15 tons may be exerted on a bollard.

Welded Screw Cylinder Bases

The use of screw-piles, in which the base of the pile is fitted with a broad flange screw, has long been recognised as a successful means of distributing the pile load over a larger area. The principle has since been developed and applied to cylinders.



View of upper surface of a welded helix.

The screws themselves have hitherto been of iron or steel cast to shape, as exemplified recently in cylinders used in the construction of the Brooking Street Wharf at Rangoon. Those who read the article in our issue of January last, will recall that the front portion of the wharf is carried on 150 screw cylinders, provided with reinforced concrete shafts, 3-ft. 6-in. in diameter, and a heavy cast iron helix at the base, 8-ft. in diameter. These cast iron helices were obtained from a foundry in Bengal, but it is not always practicable to procure large castings from local sources and sometimes they have to be imported.

A considerable saving in time and in freight and transport costs is now possible through the progress made in the art of welding. If welding and burning plant are available, the helices can be made up at the site from simple flat sheared steel plates welded together and filled with concrete. The accompanying illustration shows a helix of this type which was, to a large extent, built up from plate shearings normally sold as scrap. The top surface of the blades are fully plated as indicated.

This useful departure from conventional practice in the employment of the helix principle is due to Messrs. Braithwaite and Co., Engineers, Ltd., of Westminster, S.W.1, who have successfully developed the process for overseas contracts.

Obituary

The death took place on the 25th July of **Mr. Albert Havelock Case,** who was well-known in Westminster as a Consultant Civil Engineer of many years standing. Mr. Case, who died in retirement at the advanced age of 82, was a Whitworth Scholar and a Member of the Institution of Civil Engineers. Throughout his professional career he was chiefly connected with maritime engineering undertakings, having been engaged on foreshore protection work at Spurn Point and Hastings, on land reclamation in the estuary at Duddon, Cumberland, on dock constructional operations in South Wales and on harbour surveys and reports in South America, the Bahamas and Malta. During an association with Trinity House, London, he was Resident Engineer in charge of the construction of Beachy Head Lighthouse, which he described in a Paper to the Institution of Civil Engineers, for which he was awarded a Miller Prize. After practising some time alone, during which, among other matters, he surveyed and reported on the Great Ouse drainage system for the Lower Ouse Drainage Board, he was joined in partnership in 1922 by Dr. Brysson Cunningham, and the firm of Case and Cunningham designed and supervised the execution of a number of riverside and land drainage works for Navigation and Sewers Commissions in North Kent and South Essex. They were also consulted by the Uruguayan Government in regard to projected improvements at the Port of Monte Video. After the last European War, Mr. Case visited Russia and reported on Petrograd and Cronstadt harbours on instructions from the Board of Trade at the request of the Russian Government.

The Dragline Excavator

By WILLIAM BARNES, M.I.Mech.E.

Part 1.—The Dragline
Introduction

SHORTLY after the commencement of the twentieth century, a contractor when digging a canal in Chicago, fitted a scraper bucket to a power derrick. That application of mechanical power to a modified form of horse-drawn scraper-pan or bucket was the commencement of the dragline excavator as it is known to-day† The mechanism was so crude that it was impossible to visualize, at that time, what the idea would lead to. It is, in fact, only within recent years that engineers have realised some of the many uses and advantages of this type of single-bucket excavator. The purpose of this Paper is to enumerate and comment on these uses and advantages.

One of the great advantages of a dragline compared with its predecessor and competitor, the power shovel, is that it stands on the surface of the ground and digs below its own level. For that reason it was, at first, used mainly for under-water work, such as the cleaning out and widening of rivers, drains, and canals where a machine was unable to stand and work in the bottom. The dragline excavator is now, however, used extensively for jobs where the power shovel was, at one time, the accepted machine.

Compared with that of a power shovel the boom of a dragline is very much longer, and stability has to be considered more carefully. The working lead, that is to say, the weight of the bucket and contents, should not exceed two-thirds of the tipping or overturning load, which takes into account the swing of the bucket beyond the boom-head radius, when dumping under certain conditions (see Fig. 4).

Fig. 1. The Standard Bucket.

Not only can the boom be easily varied in length, but the working radius can be altered by means of the boom-hoist gear, which should always be incorporated. A longer radius than the one recommended with the standard or maximum size of bucket can be used if the loading at the boom head is decreased by fitting a smaller bucket. When altering the length of the boom and the bucket-capacity the effects must, however, be very carefully considered, as otherwise the working speed and balance of the machine will be adversely affected. Counterweight is usually added to the rear of the machine to obtain the necessary stability. Although this takes care of the balance it adds weight to the machine, and thus necessitates either a decrease in the slewing speed or an increase in the power required for slewing. On the modern dragline, therefore, the machinery is placed behind the centre-post, where it acts as counterweight. This reduces the amount of ballast required and effects a saving in the weight of the machine.

The dragline is usually employed as an excavating unit, but sometimes because of its long dumping reach, it is used both to dig and to transport the material. Good examples of this practice are the stripping of open-cast mines and the building of levees described in Part II of this Paper.

The dragline is a useful and adaptable machine, and improved designs, resulting from field studies and experience, have added considerably, in recent years, to its many useful applications. For instance, not long ago the recommended maximum digging depth was only about one-half of the boom-head radius or length of boom. Now, however, digging depths equal to the boom-head radius are not at all unusual and depths 50 per cent. greater than the boom-head radius are being dealt with by fitting much longer booms and using buckets of improved design. Less than 10 years ago the longest boom-length available on a standard ½-cubic-yard machine was 28-ft., whereas 50-ft. booms are now available on this size of machine, in conjunction, of course, with smaller and lighter buckets. At one time draglines were capable of digging only comparatively easy material; now, however, they are being used for really heavy material containing rock, and may even be used for excavating rock itself when it is sufficiently blasted and broken up, and when a machine large enough for the job is employed.

Largely because of the many improvements which have been introduced their use has been extended to: brickworks, both for stripping and for digging the clay; open-cast mineral mines and quarries; alluvial mineral deposits; and large public works of all descriptions at home and abroad. Many recent successes have also been due to greatly improved designs of booms and buckets and to the use of modern materials and manufacturing methods.

Since the bucket is the "business end" of the machine it will be dealt with first.

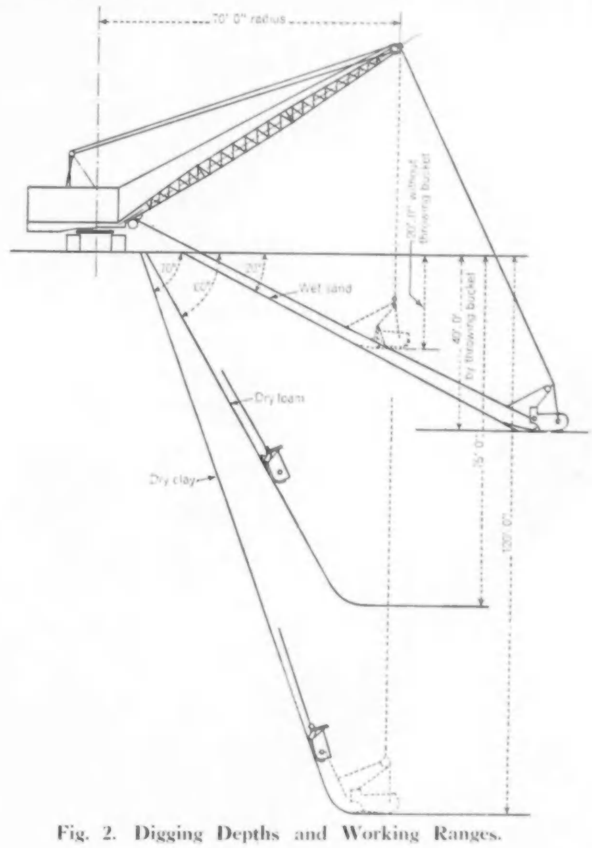


Fig. 2. Digging Depths and Working Ranges.

The Bucket

The digging efficiency of a dragline depends considerably upon the design of the bucket, and much thought and many field studies and tests have been made to determine such things as: (1) the best position of the bucket teeth and cutting lip relative to the digging pull; (2) the angle or set of teeth upon the cutting lip; (3) the cutting width of the bucket compared with its capacity and length; (4) the correct shape and curvature of the back; (5) the balance of the bucket to obtain clean dumping; (6) strength without unnecessary weight, to stand up against, not only the digging stresses, but possibly a certain amount of maltreatment when the bucket is lowered or " thrown " into the bottom of the cut under the combined control of the hoist and drag ropes.

Manufacturers, at one time, were content with one design or type of bucket, irrespective of the work the machine would be called upon to do, whereas, at the present time, four different types and weights of buckets are usually obtainable as follows: (1) a standard bucket, for average digging; (2) a light bucket, for easy digging; (3) an "ultra-light" bucket, on small machines, for removing mud and soft materials from rivers and drains; and (4) a strong heavy bucket for digging very heavy material, including rock or minerals. This last type is available only on medium-sized and large machines when the power available is sufficient for heavy duty.

The Standard Bucket

Fig. 1 shows the latest type of standard dragline bucket which has been evolved from field experience in all kinds of digging;

*Extracts from Paper read before the Institution of Civil Engineers, on February 20th, 1940, and reprinted by permission from the Institution Journal

†W. Barnes, "Excavating Machinery." Ernest Benn, Ltd., London, 1928.

The Dragline Excavator—*continued*

it incorporates many practical features which have greatly increased digging efficiency and reduced wear and maintenance costs. Modern all-welded construction has replaced the riveting previously employed, and this, together with carefully studied scientific design incorporating strength where it is most needed and reducing weight in other places, has produced a much stronger bucket than those previously used, although weighing between 25 and 30 per cent. less.

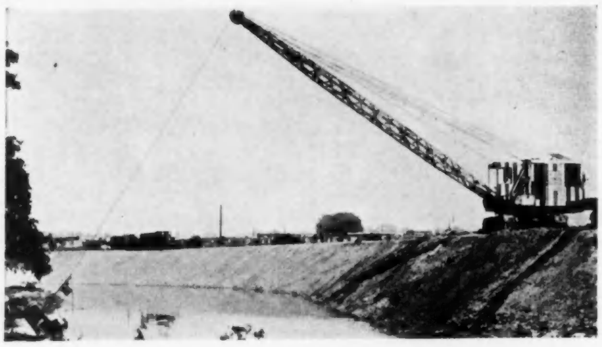


Fig. 3. "Throwing" the Bucket for Digging.

Flat plates, although heavy, offer very little resistance to bending or twisting stresses, so that in this new bucket the body plate has been reduced in thickness and then strengthened by welding stiffeners where the greatest stresses and wear take place. These welded stiffeners are clearly seen around to the top inside and outside edges of the bucket, and along the sides near the bottom. In addition, square-section rubbing pieces are welded on to the underside of the bucket to protect the body plate as it is dragged along the material which is being excavated. Another great advantage of the all-welded bucket is the absence of rivet heads inside the bucket, which results in a smoother and cleaner surface for both digging and dumping.

Another weak feature of the old dragline bucket was the tendency for the sides to pull in at the front, where the drag chains are attached due to the resultant inward pull of the chains, This weakness has been eliminated by fitting an all-welded box-section arch and a cast manganese-steel lip which greatly stiffen the front of the bucket. The manganese-steel front has sockets into which are fitted renewable and reversible alloy-steel or high-carbon-steel teeth.

Wear on the pins and shackles which attach the drag and hoist chains to the bucket and rope connections is severe, so that large circular links of alloy or manganese steel are fitted on the new buckets, to distribute the pressure and reduce the wear.

Floating brushes on the bale lug pins, special quick-change renewable steel links, and other details are all the result of the previously-mentioned field studies.

The Light Bucket

The light bucket is similar in construction to the standard bucket, except that the body plate is a little thinner and an alloy-steel plate lip replaces the one of manganese steel. Less stiffening is employed and the bucket is about 20 per cent. lighter in weight than the standard bucket.

The "Ultra-Light" Bucket

The "ultra-light" bucket has very little stiffening by comparison with the standard and light buckets and is only suitable for cleaning out mud and light materials from drains and rivers. It is about 40 per cent. lighter in weight than the standard bucket, and will not stand much punishment.

The Heavy Bucket

The heavy bucket is similar in general design to the standard bucket, but is heavier and stronger. More steel castings are employed in its construction and it is about 25 per cent. heavier than the standard bucket.

There are several advantages in being able to choose a bucket to suit the nature of the digging. For example, if a standard bucket of 1-cubic-yard capacity and weighing 2,250 lb. is used for digging stiff moist clay weighing 3,000 lb. per cubic yard, the gross load is 5,250 lb. This can be assumed to be the safe working load. Supposing, however, that the same machine is required to dig loamy soil or easily-excavated dry clay weighing 2,200 lb. per cubic yard, then a $1\frac{1}{4}$-cubic-yard light-type bucket weighing 2,270 lb. can be used, as the $1\frac{1}{4}$ cubic yard of material will weigh only 2,750 lb.; the gross load will therefore be 5,020 lb., compared with the gross load of 5,200 lb. when using the 1-cubic-yard standard bucket in heavy clay. As the loamy soil is easy to dig the $1\frac{1}{4}$-cubic-yard bucket can safely be used. It will be seen, therefore, that, by changing the bucket at a comparatively small cost, 25 per cent. greater output is obtainable.

Users are recognising that the lighter the bucket, consistent with its ability to dig, the greater the efficiency or pay load, and, if a larger output is required or can be dealt with, the increase in output quickly pays for a new bucket. One user consistently uses the lightest bucket obtainable, saying that the larger output he obtains more than pays for the greater maintenance costs of the light bucket.

Sometimes digging and dumping radii are of greater importance than output, especially for cleaning out rivers or drains, and it may be possible to increase the length of boom by fitting a lighter bucket. An example is a dragline with a working radius of 40-ft. using a 1-cubic-yard standard bucket weighing 2,200 lb. in material weighing, say, 2,500 lb. per cubic yard, giving a gross load of 4,700 lb. On most drain-and river-clearance jobs a light-type bucket will readily handle the material, so that if a 1-cubic-yard light-type bucket weighing 1,900 lb. is substituted for the 1-cubic-yard standard bucket it is quite practicable to increase the radius to 45-ft., which may be a considerable advantage.

A wide range of dragline buckets is available, capacities ranging from $\frac{1}{4}$ cubic yard upon a machine weighing 7 tons to 20 cubic yards upon a machine weighing 1,200 tons.

The Boom

Mention has already been made of the great advance which has taken place in boom-lengths during recent years, even upon machines of the same bucket-capacity.

Formerly, all booms upon machines up to about $1\frac{1}{2}$-cubic-yard bucket-capacity were constructed of mild-steel channels, and, upon larger machines, of mild-steel angles with riveted lattice bracings.

Recently, however, riveting has been replaced by welding, and this, together with improved designs and the use of modern materials, has reduced the weights of the booms. In addition, the boom fittings, especially the boom-head connections and pulleys, have been reduced in weight. Everything, in fact, has been done to obtain minimum weight with adequate strength to obtain the big working ranges which are useful features of modern draglines. Better balancing of machines has also helped the adoption of longer booms.

The modern dragline boom is usually built up of a number of sections so that its length can easily be altered to suit different working conditions. For instance, the standard length of boom upon a certain machine is 60-ft., and it is constructed of two sections; it carries a bucket of $2\frac{1}{2}$ cubic yards capacity. The same boom can, however, be increased in length to 70, 80, or 90-ft. by adding sections 10-ft. long, bolted between the two main sections, to take buckets of 2, $1\frac{1}{2}$, and $1\frac{1}{4}$-cubic-yard capacities, respectively. This is frequently very useful, as sometimes, on different parts of the same job, greater or smaller digging ranges are required and therefore the booms can be altered to suit. This sometimes obviates the necessity of installing another machine.

Fig. 4. "Throwing" the Bucket for Dumping.

WORKING RANGES.

Digging Depth

The practical digging depths of dragline excavators have increased enormously within recent years, and, in certain cases, have more than doubled, chiefly because of the use of longer booms and more efficient buckets.

Given a definite boom-length and a modern bucket, the maximum digging depth is now dependent almost entirely upon the nature of the material, including its hardness or the resistance it offers to the bucket teeth and its natural angle of repose, as shown diagrammatically in Fig. 2. In this diagram three representative materials are shown; wet running-sand with a natural angle of repose of 20 degrees; dry loam or similar material, very easy to dig, with an angle of 60 degrees; and dry clay standing up to an angle of 70 degrees.

It is apparent that wet running sand is a difficult material to deal with because as fast as the material is dug from the toe and the face it " flows " to a flat angle of repose which greatly limits the digging depth. The longer the boom the greater of course, will be the possible digging depth. In the diagram the bucket in running sand is shown thrown well out beyond the boom-head radius, which is good practice for certain jobs, not only in shallow digging, but in faces with a normal depth.

The Dragline Excavator—*continued*

A study of Fig. 2 will make it clear how the maximum digging depth depends upon the boom-head radius and the angle of the working face.

It is only possible to excavate the dry clay shown at the steep angle if the material is not too hard to be dug with the bucket resting on the face of that angle, because, of course, the pressure upon the teeth due to the weight of the bucket is, comparatively speaking, very small. The fact, however, that digging to about this depth is practicable is proven by a dragline, with 70-ft. boom and 1½ cub. yd. bucket, which is digging clay to a depth of over 100-ft. near Bletchley.

To take an extreme example, if the material stood vertically, the bucket would also hang almost vertical on or near the face, and in that position there would be practically no pressure or weight upon the teeth to penetrate the material.

Digging Radius

Fig. 3 shows that the bucket can be thrown out well beyond the boom-head to increase the digging radius, thus enabling a wider cut to be taken. This is especially useful for cleaning out rivers and drains. The length of throw beyond the boom-head, which can easily be 30 per cent. greater than the boom-head radius under favourable conditions, depends, to some extent, upon the depth of the excavation or surface of the water below the working-level of the machine. The maximum and easiest throw is obtainable when the material or surface of the water is well below the working-level of the machine, so that a normal pendulum swing from the boom-head is obtainable; otherwise the length of the pendulum swing must be reduced, by shortening the hoist rope, so that the bucket will clear the material or water at the lowest point of its swing. In deep faces, it is difficult to co-ordinate the "paying-out" of the drag and hoist ropes to avoid dropping the bucket heavily in the bottom. Under these conditions, to prevent possible damage to the bucket, it is advisable to lower the bucket at the boom-head radius and to make no attempt to throw it. It should be borne in mind that throwing the bucket increases the cycle time, so that if maximum output is required it is better to use a larger machine with a longer boom.

Fig. 5. The "Walking" Dragline.

Dumping Radius

For dumping into wagons the dumping radius is equal to the boomhead radius as the bucket is suspended vertically from the boom-head by the hoist rope. For dumping to spoil or back into water the bucket can, however, be swung out several feet beyond the boom-head. This practice is useful sometimes to increase, slightly, the dumping radius (Fig. 4) or to spread material.

Dumping Height

The bucket can be dumped at any height from a point immediately under the boom-head to a reasonable distance below the working level of the machine.

Digging Powers and Speeds

The digging power should bear a definite relation to the capacity of the bucket and the speed should be as high as is consistent with control of the bucket during the progress of the cut. If the speed is too high the bucket cannot be filled efficiently Field experience under many different conditions has determined the best digging powers and speeds.

Modern practice indicates that, in average material under average digging conditions, the drag pull, which is approximately the digging effort upon the bucket-teeth, should be between 16,000 and 18,000 lb. per cubic yard of bucket-capacity for small machines, approximately 14,000 lb. per cubic yard for 3 cubic yard machines, and approximately 12,000 lb. per cubic yard for 12 cubic yard machines, with digging speeds between 140 and 180-ft. per minute.

To avoid loss of time in dumping, the hoisting and slewing motions should be carried out simultaneously so that the correct dumping height coincides with the end of the swing. This means that for high dumping, either on to a bank or into a hopper, the bucket has to be hoisted higher during the slewing period. Since slewing speeds are faster on modern machines the hoisting speed has been increased from about 110-ft. per minute to 150-200-ft. per minute. More powerful engines or electric motors are also fitted to obtain the greater digging, slewing, and hoisting speeds.

Variable Digging Powers and Speeds

Another valuable feature of the modern dragline is the provision of interchangeable drum laggings of different diameters, by means of which the digging pulls and speeds and also the hoisting speeds can be altered to suit different conditions. Thus, for hard digging, a small drum lagging is bolted to a permanent drum spider mounted on the drum-shaft to obtain a powerful cutting effort. This lagging is in halves to facilitate changing. Inversely, for easy digging a larger drum lagging can be fitted to increase the digging speed and yet retain sufficient digging power to deal with the easier material.

For very deep digging, large diameter drum laggings are available to avoid, as far as possible, coiling the rope in more than one lap or layer. This increases, of course, the digging and hoisting speeds and proportionately decreases the digging and hoisting pulls, but this, generally speaking, is not a disadvantage as, because of the deep face, a thinner cut, requiring less cutting effort, is taken to fill the bucket over the longer distance resulting from the deep face. A smaller bucket is also usually employed, because of the longer boom which is necessary to deal with the deep cut. The reduced drag and hoist pulls are therefore sufficient for the smaller bucket and a comparatively fast operating cycle is maintained, even in the deep face.

Motive Power

Internal combustion engines or electric motors are used, almost exclusively, for the motive power. They have superseded steam engines because of the difficulties and expense, with steam machines, of obtaining coal and suitable water, maintaining an adequate working pressure throughout the day, raising steam in the morning, washing out the boiler at regular intervals, and the expense of a fireman. In practice, also it is found that larger average outputs are obtainable from excavators driven by electric motors or by internal combustion engines than from steam machines. Field records show that the net working time, with steam as the motive power, averages from 65 to 75 per cent. of the gross working hours compared with from 85 to 90 per cent with internal combustion engines and from 90 to 95 per cent. with electric motors.

For use in permanent situations such as pits and quarries, electricity is usually favoured, but contractors and users who have to move the machines about from place to place naturally prefer diesel or petrol engines as the motive power.

The recognised practice for draglines with buckets up to 2 or 2½ cubic yards capacity is to fit a continuously-running internal combustion engine, or electric motor, and to drive all the various motions through friction clutches. When the clutch-operated type of machine was first introduced a considerable amount of prejudice had to be overcome in spite of the fact, that, even when separate steam or electric power units were employed for the various motions, clutches and brakes were necessary for controlling the digging and hoisting motions and the only additional clutch required for the clutch-driven dragline was for the slewing motion. It must be admitted, of course, that when clutch-driven machines were first introduced the clutches were

The Dragline Excavator—*continued*

anything but perfect. Upon modern machines, however, the clutches are very efficient both for easy operation and long life, with consequently low maintenance costs, which probably accounts largely for the fact that at least 95 per cent. of the excavators now constructed are clutch-operated. The remainder consists chiefly of large machines fitted with Ward-Leonard electric control where, if clutches were used, they would be so large and heavy that they would be difficult to operate. This applies, however, to the slewing and travel clutches, as, even upon the largest draglines, the digging and hoisting motions are necessarily controlled through power-operated clutches.

Large draglines of what is known as the "walking" type (which are described later in this Paper) are also obtainable fitted with Diesel engines as the motive power, for situations where electric power is not available. Some of these machines weigh more than 600 tons and are fitted with Diesel engines of 600 horse power. Upon these machines the Diesel engines, in addition to providing direct power to the digging and hoisting motions, drive generators with Ward-Leonard control which supply current to the slewing motors.

In order to obtain the greater digging power and operating speeds characteristic of modern machines, larger power units per cubic yard of bucket-capacity are now employed, so that the horse-power now ranges from 70 to 90 per cubic yard of bucket-capacity, compared with about 50 to 60 on early models.

Caterpillar Tracks

Caterpillar tracks, self-laying tracks, or crawlers, as they are variously called, are among the most useful and revolutionary features ever introduced upon excavators. They add from 25 to 35 per cent. to the cost of an excavator, compared with rail wheels, but in spite of this, and because of the increased mobility and great saving in time and labour resulting from their use, they have replaced entirely the rail and road wheels previously used.

The usual bearing or ground pressure on caterpillar tracks varies from 10 to 15 lb. per square inch, which is suitable for travelling on ordinary ground without the use of timbers or wood mats. For soft ground, however, specially long and specially wide tracks are available which, depending upon the size and make of machine, reduce the bearing-pressure to 7-10 lb. per square inch.

For power shovels, long tracks are not advisable, as they do not allow sufficient working clearance around the machine for the shovel bucket, or dipper, as it is frequently called to distinguish it from the bucket of a dragline. This disadvantage does not, however, apply to a dragline and frequently it is very desirable to use the specially long and wide tracks. Sometimes the ground, as, for instance, soft marshy ground alongside a river, is too soft even for oversize caterpillar tracks and for these conditions timber mats or rafts should be used. These mats, because of the large area upon which they stand, result in a low bearing pressure of the order of 2-5 lb. per square inch, depending upon the area of the mats and the size of the machine.

The foregoing remarks refer to draglines up to about 80 tons in weight. For very large draglines whose weight runs into hundreds of tons, as high in fact as 1,200 tons, the matter of bearing pressures becomes a more difficult problem, owing to the difficulty and expense of fitting caterpillar tracks proportionate to the weight of the machine. The bearing pressure upon the tracks of the largest machines runs as high as 40-45 lb. per square inch. This can be more than halved by the use of timber mats under the tracks, but for some conditions this is still high, although it can be reduced to a more workable figure by specially large mats. This, however, entails loss of time and extra cost of labour in laying them down.

The "Walking" Dragline

The problem of weight and bearing pressure on very large draglines has been solved by the use of what is known as the "walking traction" device shown in Fig. 5. Machines fitted with this device were at first used chiefly on the soft ground alongside the Mississippi River for building levees, but they are finding increasing favour for other classes of dragline work, and hundreds are in use in America. Six of them have recently been put to use in the Nigerian tin fields and five in the English ironstone mines. Two, weighing over 600 tons each, were supplied to steelworks in Germany in 1939.

When the "walking" dragline is in operation the superstructure can revolve on a big circular base which "sits" on the ground and takes the place of the more usual caterpillar tracks. This base ranges from about 18 to 36-ft. diameter (according to the size of the machine) and results in the low bearing pressure of 5-9 lb. per square inch.

Large shoes or rafts, lifted well clear of the ground when the machine is digging, are fitted to the machine, one on each side of the revolving frame. When it is required to move the machine to a new location the "walking" machinery is put into motion and the two shoes are simultaneously lowered on to the ground until the weight of the machine is transferred from the base to the shoes. As the motion continues the whole machine, exclusive of the shoes, of course, is first lifted and tilted and then moved forward a distance of 6 or 7-ft., the rear portion of the machine, meanwhile, trailing on the ground. The tilting motion of the machine ingeniously breaks the suction under the base on soft ground. A very important and useful feature of the "walking" device is that the machine can step off or "walk" in any direction by simply slewing the superstructure into the direction in which it is required to move.

(To be continued).

Commission of Public Docks, Portland, Oregon

Excerpts from Twenty-ninth Annual Report of the Chairman (Mr. John H. Burgard) for Year ended November 30th, 1939

Finances.—During the past year, as in the preceding twenty-eight, the Commission has met all of its obligations in full and as due. Up to November 30th, 1939, the Commission had retired \$4,980,200.00 of its bonded debt.

The cost of maintenance for 1939 amounted to \$105,396.82. The 1940 Budget called for a levy of \$619,340.00, which was \$20,761.50 under the 1939 levy. The past year showed a marked improvement over 1938. Gross operating revenues, the greatest since 1931, were \$442,472.53 as compared with \$290,703.87 in 1938.

Shipping.—The port enjoyed a substantial tonnage increase in 1939 over the preceding year. In 1939 the total deep-sea and inland waterway tonnage for the port amounted to 9,527,996 tons valued at \$308,932,477.00, compared to 7,353,378 tons valued at \$273,258,096.00 in 1938. For the same period the port's deep-sea tonnage was 1,077,798 tons greater in 1939. The deep-sea tonnage handled over the Commission's facilities in 1939 amounted to 643,436 tons against 629,466 tons in 1938.

Bonneville Dam.—Though the Dam was dedicated in September, 1938, the locks were not opened to navigation till January, 1938, and since then river transportation on the Columbia has received marked impetus. During 1939 a total of 80,588 tons moved downstream through the locks and 220,278 tons moved upstream, of which latter tonnage petroleum products constituted nearly all the tonnage. In February the first barge-load of bulk wheat reached Terminal No. 4 from Port Kelley, over 200 miles up the Columbia River. In preparation for an increasing river movement of bulk commodities, there has been considerable new construction of barges and tow-boats during the year.

The Port of Beira, Mozambique in 1939-40

During the year ended March 31st, 1940, 657 ships entered the port, representing a gross tonnage of 3,858,265 tons, and the tonnage of cargo unloaded and transhipped amounted to 370,607 metric tons. During the same period 658 ships sailed from the port, representing a gross tonnage of 3,865,074 tons, and the tonnage of cargo loaded and transhipped amounted to 591,734 metric tons.

The total cargo loaded, unloaded and transhipped, including coasting vessels' cargo, during the year, amounted to 962,341 metric tons, representing a decrease as compared with the previous year of 118,051 metric tons.

Total imports at 410,009 tons were 63,015 tons, or 13 per cent. lower than in the previous year, due to the effect of the war, the main decrease being in importation of railway materials and mining and industrial machinery of 44,400 tons and 26,600 tons respectively.

Total exports amounted to 608,142 tons, a decrease of only 26,406 tons, or 4 per cent.

The fourth and fifth deep water berths, equipped with cranes, and one transit shed on Berth No. 1 and the extension of the electric power plant are now in use; the remaining improvements, comprising transit shed accommodation, reclamation of land behind the wharves, and re-arrangement of tracks, will be completed very shortly.

Revenue and Expenditure

Revenue from wharf dues, dredging tax, haulage and storage charges, etc., amounted to £539,755, as compared with £562,394 for the year ended March 31st, 1939.

The expenditure of £264,678 during the year ended March 31st, 1940, included £40,278 provision for depreciation of wharves, wharf equipment, floating craft, plant and buildings, whilst the expenditure of £287,444 in the previous year included £39,217 for depreciation.

The Port of Los Angeles, U.S.A.

Description of a Leading Pacific Coast Port

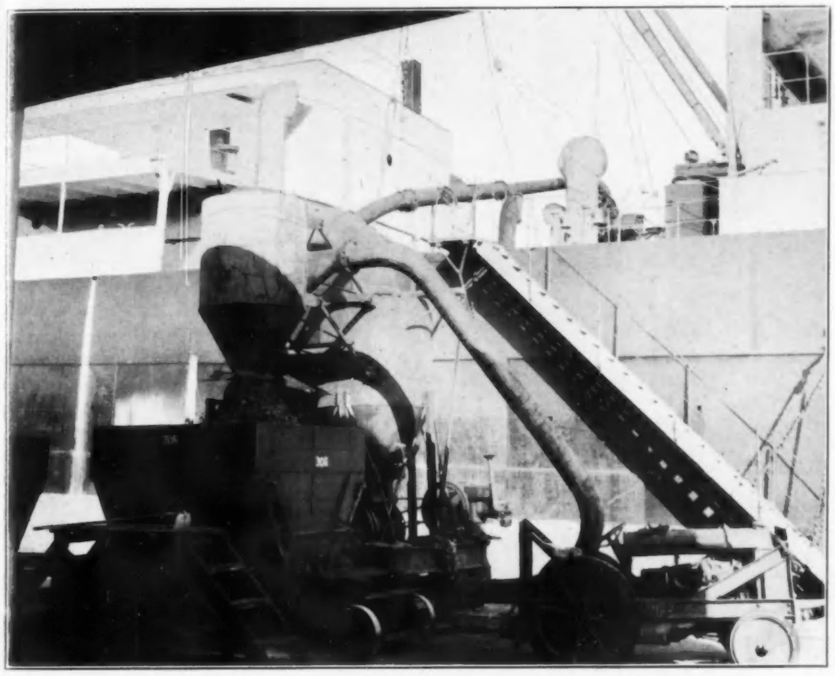
By G. E. ARBOGAST, President, Los Angeles Board of Harbour Commissioners.

(Concluded from page 226).

Commercial Activities

Port Commerce.—The total commerce through the Port during 1938-39 was 18,327,890 tons valued at $986,626,114, as compared with a total for the year 1937-38 of 20,264,264 tons valued at $990,906,671.

Decrease in tonnage and value of tonnage for 1938-39 as compared with the previous year was due to a decline in oil exports, chiefly to Japan, owing to unsettled conditions in the Far East.



Unloading copra by means of mechanical handling equipment.

General cargo showed an increase of 4,154 tons and an increase in value of $7,534,000 over last year. The totals were 3,378,436 tons valued at $778,805,972 for 1938-39 as compared with 3,374,282 tons valued at $771,271,322 for 1937-38. General cargo represents all commodities other than lumber and bulk petroleum, and this class of cargo effects every business in Southern California. Coastwise general cargo shipments showed an increase in both inbound and outbound movements for the past year. Inter-coastal outboard general cargo increased 25,145 tons over last year.

Vessels arriving at the port during the past fiscal year numbered 5,766 as compared with 5,702 the preceding year.

Fishing Industry.—During the past 20 years, the fishing industry has risen to a position of international importance in the production and distribution of canned fish and bi-products of the canneries. Fourteen canneries, giving employment to about 3,800 workers are connected with the Port and the fishing fleets employ a further 2,300 men. The total catch during the last fiscal year amounted to 175,688 tons, of which 60,039 tons, valued at $13,308,465 was exported.

Petroleum Industry.—For the past two decades, petroleum has constituted a major item of commerce of the Port, and last year exports of this product totalled 13,893,636 tons valued at $183,711,397. Ten oil companies operate from the Port, and between them, maintain 26 oil berths equipped with the most modern appliances and all provided with adequate fire protection. All the companies, excepting one, operate over municipally-owned wharves for which they pay dock and wharfage dues.

Lumber Trade.—During the past year, 1,045.492 tons of lumber, valued at $23,800,688 were imported. The principal timbers were, fir and redwood from the Pacific north-west, and hardwoods from the Philippines, Japan, Mexico, South America and other distant ports. In addition to the areas occupied by the Municipal Lumber Wharves, nine lumber companies occupy approximately 200 acres of water front.

General.—Other important industries include the banana trade, cotton, copra and vegetable oils, walnuts, rubber, borax and citrus fruits.

Dry Docks and Shipbuilding

Two dry dock and shipbuilding corporations operate large plants at Los Angeles Harbour; The Bethlehem Steel Co., Shipbuilding Division, San Pedro Yard; and Los Angeles Shipbuilding and Dry Dock Corporation.

The Bethlehem San Pedro Yard is located on Terminal Island at the entrance to Los Angeles Harbour, providing convenient access for ships coming to the yard from the sea, as well as from the harbour. This plant, covering 38 acres, is known as a ship-repair yard and constitutes a unit as such in the nation-wide Bethlehem organisation.

The San Pedro yard is a complete unit and the floating dry dock which has a lifting capacity of 15,000 tons, is the largest in Southern California. The plant is equipped to recondition and repair all sizes and types of ships and floating equipment.

The Los Angeles Shipbuilding and Dry Dock Corporation has a large yard located in the West Basin. This plant is equipped for the construction of vessels up to 500-ft. in length, as well as the repair of all types of vessels. A floating dry dock with a lifting capacity of 12,000 tons, and a small marine railway for handling small craft are also operated by this company.

The Marine Exchange

When in 1919-20, the commerce and shipping of Los Angeles Harbour began to assume important proportions and local shipping men and world traders saw the imperative need for a centre to gather and disseminate information of ships and their cargoes, the local Marine exchange was inaugurated.

Since 1926 the Exchange, a self-supporting non-profit organization, has been operated under the supervision of, and with headquarters office in, the Chamber of Commerce at Twelfth and Broadway, Los Angeles.

Broader in scope and comparable at least in efficiency with similar organisations at other world ports, factual information with regard to ships and shipping through this port is gathered and disseminated to all shipping interests news-mediums, shipping guides, exporters and importers, and to the general public.

Located at the harbour entrance at a point of vantage 100-ft. above sea-level on the roof of the six-storey Municipal Warehouse No. 1, a look-out station is maintained where six sea-trained look-outs provide a continuous 24-hour watch and service to all shipping interests. Equipment includes a powerful 4-in. observation telescope (40-60-120 power) with which arriving vessels are sighted and identified an hour or more before they reach Breakwater Light. Advance notification (35 to 40 calls on each vessel arriving) is thus given to steamship agents, ship suppliers, and, as occasion requires, to Port Pilots, Tug Boats, Federal Bureaus, such as United States Customs, Public Health (Quarantine), Immigration, and to other interests.

Ships arriving after sundown are communicated with in International Code, using the blinker-light system of telegraphy. The six men employed as look-outs are expert telegraphists.

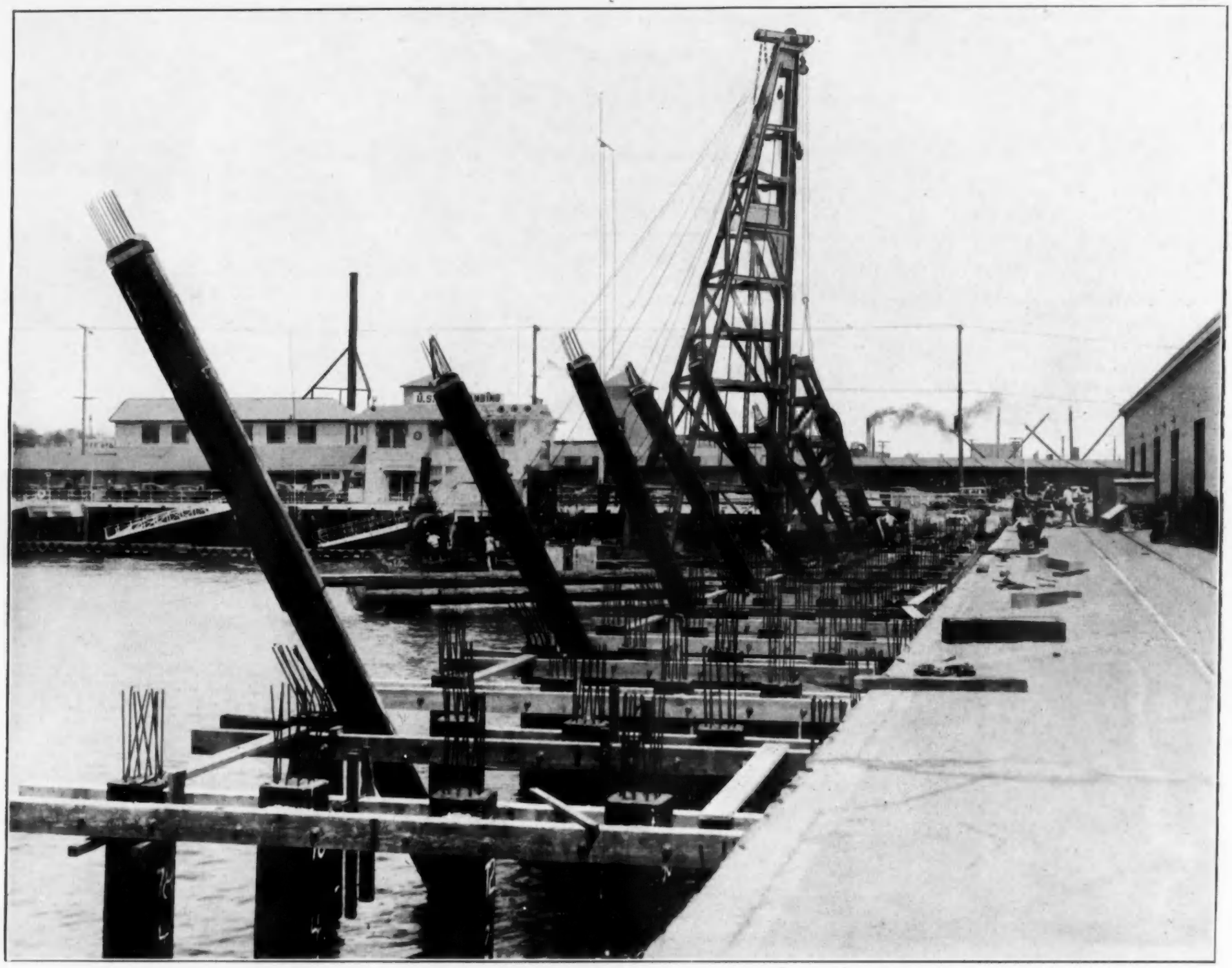
Strategically located immediately alongside and to the west of the entrance to the main channel, look-outs can communicate by megaphone with vessels passing in or out of the harbour.

Information pertinent to ship arrivals, intra-harbour movements, departures, casualties, weather conditions, and other maritime intelligence is promptly relayed to all subscribers ashore by multiple telephone trunk lines, telegrams, messenger service, and mail, as the necessities of each case require.

Fire Protection

The Port of Los Angeles is equipped with a very efficient fire fighting service. Because of the wide expanse

Port of Los Angeles—continued



Driving Reinforced Concrete Asphalt impregnated brace piles in Apron Wharf at Berth 57-60.

of the port, there have been provided three fire-boats, two stationed midway between the inner and outer harbours on the Main Channel, and the other in the Fish Harbour District.

Fire Boat No. 2, on the Main Channel, is the largest and most fully equipped in the United States. The hull is of steel throughout, with an overall length of 99-ft. It has five monitor-turret nozzles, each capable of delivering three thousand gallons of water per minute. It is also equipped with carbon dioxide set with a capacity of 900 lbs., which is of great importance in fighting oil fires. The vessel has a speed of 17 miles per hour and can throw streams totalling 12,000 gallons of water per minute.

Fire Boat No. 3 is used to fight small fires and has a maximum speed of 20 miles per hour, which makes it possible to reach any point in the harbour in the event of fires among the smaller craft in shallow water. Fire Boat No. 1, of the intermediate size, has a capacity of 3,000 gallons per minute.

There are also seven land fire companies. The total fire-fighting personnel, in the harbour district, consists of 184 men under the direction of an Assistant Chief.

Engineering, Construction and Maintenance

During the past year, the Engineering Division continued to handle a considerable amount of work in connection with the P.W.A. harbour development projects under construction, and in connection with the extensive reconstruction programme necessitated by maintenance of many facilities which had reached a stage of deterioration requiring general repairs to entire wharf structures, a condition brought about by their hasty erection in providing facilities to accommodate the phenomenal increase in volume of cargo at the Port and the fact that untreated timber was used in the deck system. In the general maintenance of these older structures, creosoted material is being substituted for untreated timber, and advantage is taken of the opportunity to make improvements in the design of the older facilities.

Federal grants for Public Works Administration projects were made for the construction of a reinforced concrete apron wharf at Berths 57 and 60, utilising asphalt impregnated concrete piling; for the extension of the terminal facility at Berth 181 and its conversion from a cased oil facility to a combined general cargo and cased oil terminal; for the erection of a building to house a blacksmith and welding shop; and for the construction of an office building for the Harbour Department Purchasing Agent. The total estimated cost for the above work is $925,791.00, of which amount the Board of Harbour Commissioners will finance 55 per cent.

Concrete Apron Wharf at Berths 57-60.—The general cargo facility at Berths 57 to 60, one of the earliest municipal developments in the harbour, was constructed with an apron along the waterside of the shed of a width only sufficient to permit installation of mooring bitts and rubbing strips. In 1924 a timber apron wharf, for the full length of approximately 2,500 linear feet, with two railroad tracks, was constructed along the channel side of the shed, using creosoted piling and an untreated timber deck structure. Limnoria infestation, which is extremely active even in treated piling in this section of the harbour, set in, and by 1937 railroad operation over the wharf tracks were restricted, until replacement of the entire structure became imperative.

In the reconstruction of the apron wharf at this location the specifications provide for asphalt impregnated concrete bearing and brace piling supporting a reinforced concrete deck system protected with a creosoted pile fender system used, for some time, successfully throughout the harbour. Contracts for the construction of the wharf were awarded, and by the end of the fiscal year the project was approximately 20 per cent. completed.

Extension of Cased Oil Terminal at Berth 181.—The temporary shelter shed at Berth 181, constructed in 1924, in conjunction with a contiguous concrete structure built in 1930, served as a cased oil terminal, with protecting fire floodwalls, until recent years when tonnage of this commodity to the Orient was severely restricted as the result of conditions obtaining in Asia.

The urgent need for additional general cargo terminals at the port necessitated extension of the terminal at Berth 181 and its conversion from a facility used strictly for cased oil to a combined general cargo and cased oil terminal. The project, comprising construction of a concrete wharf, an extension to the transit shed, installation of removable floodgates, and the construction of a loading platform along the rear of the entire facility served by lowline tracks and paved trucking areas with connections to Anacapa Street, was nearing completion at the end of the fiscal year.

Port of Los Angeles—continued

Office and Shop Buildings.—The original timber frame store house at the Harbour Department Supply Yard, which housed the Purchasing Agent's office since 1910, outgrew its usefulness and was inadequate for the proper transaction of business, and advantage was taken of Federal assistance to construct a two-storey concrete office building on the site of the old structure.

A concrete blacksmith and welding shop was also constructed at the Harbour Department Supply Yard to replace the former structure destroyed by fire in January, 1936.

These buildings have been treated, architecturally, to harmonise with other structures in the Supply Yard, and were nearing completion at the end of the fiscal year.

Bluff Harbour Board, New Zealand

Excerpts from Chairman's Annual Address on operations of the Board for the Year ended 30th September, 1939

Income and expenditure are summarised as follows:—

	£
Income	51,462
Ordinary Expenditure	35,800
	15,662
Less Depreciation	8,462
Nett profit	7,200

The balance for the year 1938 was £3,597.

Trade.—The tonnage of cargo handled through the Port for the 12 months was:—Imports, 83,295; Exports, 86,853, making a total of 170,148 tons.

The figures for the same period, 1938, were:—Imports, 95,470; Exports, 83,207, making a total of 178,677 tons.

This shows a decrease compared with the previous year, of 12,175 tons imported and an increase of 3,646 tons exported or a total cargo decrease of 8,529 tons.

Shipping.—The number of vessels which have worked cargo at Bluff during 1939 and three preceding years, has been:—

	Coastal	Overseas and Intercolonial	Total
1936	362	137	499
1937	395	120	515
1938	372	128	500
1939	396	119	515

Port of New York Authority

Extracts from Annual Report for year ended 31st Dec., 1939

The nineteenth annual report of the Port of New York Authority contains particulars of operations carried out during the year, as shown by the following extracts:—

A sum of nearly eight million dollars was expended on channel improvement in the Port District by the United States Government, principally on the following:—

Arthur Kill and Kill van Kull channels (Staten Island Sound): Dredging to 35-ft.; Hudson River: Deepening of the main shipping channels from the harbour entrance to 40th Street, Manhattan, to 45-ft.; thence to 48-ft. to 59th Street; Hudson River-Weehawken-Edgewater channel: Maintenance to 30-ft. depth; Buttermilk and Red Hook channels between the Brooklyn waterfront and Governors Island: Deepening to 35-ft. and 40-ft. depths.

The New York State Barge Canal is an important feeder to the Port of New York, provides a water route competitive with the St. Lawrence canals serving Montreal and the Mississippi River system serving New Orleans, and is an important factor in keeping down railway and truck rates to the interior. Because of these considerations the Port Authority, in 1934, took a leading part in securing a federal grant to the State of New York for the raising of bridges to a minimum of 20-ft. vertical clearance, the widening of bends and deepening throughout to 14-ft. These improvements, which affect that portion of the canal between Oswego and Albany, are now about 65 per cent. complete and 77 per cent. of the federal funds necessary to finish the work has been allotted for the purpose.

Grain is an important item in the export trade of the port. The exports since the beginning of the 1939 season (October to December) have averaged 3,882,000 bushels per month. a 269 per cent. increase over the corresponding period of 1938. Although some all-rail grain moves from Illinois and other United States shipping points, the major volume is of Canadian origin shipped from Great Lake ports by rail or New York State Canal. Removal in January, 1939, of impediments to the export of Canadian grain to the United Kingdom via New York and other United States ports, for which the Port Authority has worked since 1933, was a large factor in the revival.

Following out its duty to make recommendation for the better conduct of navigation and commerce, the Port Authority has for several years urged on federal and municipal authorities more adequate regulation and supervision of the handling of dangerous articles within the port area. Legislation is now pending in Congress which is intended to co-ordinate existing statutes covering this traffic. Under the proposed Act, which is was hoped would be passed and become effective early in 1940, the Secretary of Commerce is empowered to regulate the safe transportation of explosives and other dangerous cargo on board vessels on the navigable waterways of the United States. In anticipating this legislation the Bureau of Marine Inspection and Navigation of the Department of Commerce has already compiled and issued a preliminary draft of a new comprehensive set of proposed regulations. These rules will givern the transportation, stowage and storage of all dangerous cargo on board vessels entering or clearing United States ports. A number of conferences covering the preliminary draft have been held by the bureau with shipowners, shippers, marine underwriters and representatives of the Port Authority, and considerable progress has been made in eliminating technical differences which will make the rules more workable and reasonable.

Publication Received

Supplementary Type Designs for Factory Structural Steelwork.

In War-time Building Bulletin No. 1 the Building Research Station of the Department of Scientific and Industrial Research put forward economical type designs in steelwork for single-storey open shed factories. These, however, are not suitable for exclusive use in factories which require to be camouflaged, and in War-time Building Bulletin No. 4 (H.M. Stationery Office, Price 1s.), which has just been issued, the range of roof types has been extended by supplementary designs which, suitably combined with the others in the factory structure, will facilitate camouflage.

The principal difference between the two types of structure lies in the roof glazing; in the first case the glazed areas were placed vertically on the roof trusses, while in the supplementary designs the roof and glazing are sloped, and the roof trusses are symmetrical, of a double-pitched design. The extended range of type designs has been prepared for use by themselves or in conjunction with the original type designs, depending on the camouflage requirements for the factory concerned. To determine the most advantageous combination in particular circumstances, there should be consultation at an early stage between the architect and the Ministry of Home Security, Civil Defence Camouflage Department, Leamington Spa. The Bulletin has been prepared in conjunction with the Ministry of Home Security, A.R.P. Department, with whom the Camouflage Establishment is associated.

Working drawings of the steelwork are available, as before, to those engaged on factories to be erected at the instance of a government department, and may be obtained on application to the Iron and Steel Control.

In an appendix to the Bulletin a second daylight-factor protractor, intended for use with sloping glazing, is described. It is similar to the daylight-factor protractor issued with War-time Bulletin No. 1, for vertical glazing, and is available in clear celluloid price 3½d. on application to the Director, Building Research Station. With these protractors it is possible to obtain, very rapidly, an estimate of the amount of daylight entering a factory, and to determine the best location for the glazing.

Floods in the River Plate

By reason of the approach from the Atlantic Ocean to the Argentine ports of La Plata, Buenos Aires, Rosario and others further inland along the banks of the River Paraná, the estuary channels of the River Plate have navigational importance and the depth of water, subject as it is to fluctuation from combined fluvial and atmospheric influence, is a matter of frequent concern to shipping. The following recent experience is noteworthy. On April 15th-16th last, in consequence of an extraordinarily violent gale from the South-east throughout the night of the 14th and the two following days, the level of the water in the Estuary rose to the unprecedented height of 33-ft. as recorded on the Riachuelo gauge, the previous highest levels within recent years being 31-ft. on June 30th, 1922, and 30-ft. 3-in. on July 10th, 1923. There was much flooding of low-lying districts extending from Magdalena at the outer extremity of the Estuary to San Pedro, over 250 miles distant on the River Paraná. Heavy losses were incurred by the inhabitants and the industrial establishments and warehouses in the affected area.

The Dock & Harbour Authority

No. 240. Vol. XX. OCTOBER, 1940 Monthly, 1s. 6d.

To Correspondents

All Letters and Contributions intended for Publication should be addressed to the Editor of "THE DOCK AND HARBOUR AUTHORITY," 19, Harcourt Street, London, W.1, and must in all cases be accompanied by the name and address of the sender.

The Editor cannot be responsible for the safety of or return of manuscripts forwarded on approval.

To Advertisers

Our circulation is world-wide. For Advertisement Rates and particulars of space available apply to the Advertisement Manager, 19, Harcourt St., W.1

Subscription Rates

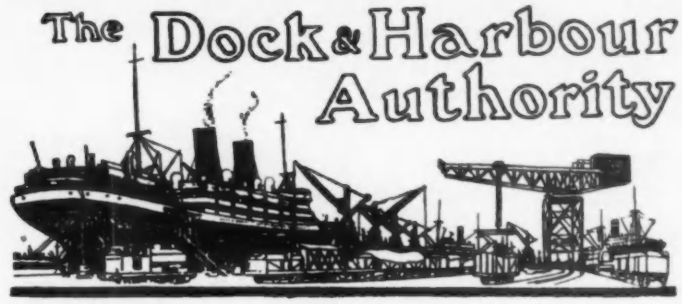
PER **1/6** COPY
1/9 Post Free.

PER **21/-** ANN.
Post Free anywhere.

All Subscriptions must be Prepaid.

Postal Orders and Cheques should be addressed and made payable to THE YACHTSMAN PUBLISHING COMPANY, LTD., 19, Harcourt Street, London, W.1 and crossed Midland Bank, Ltd.

Telephone: PAD. 0077 & 0078



CONTENTS